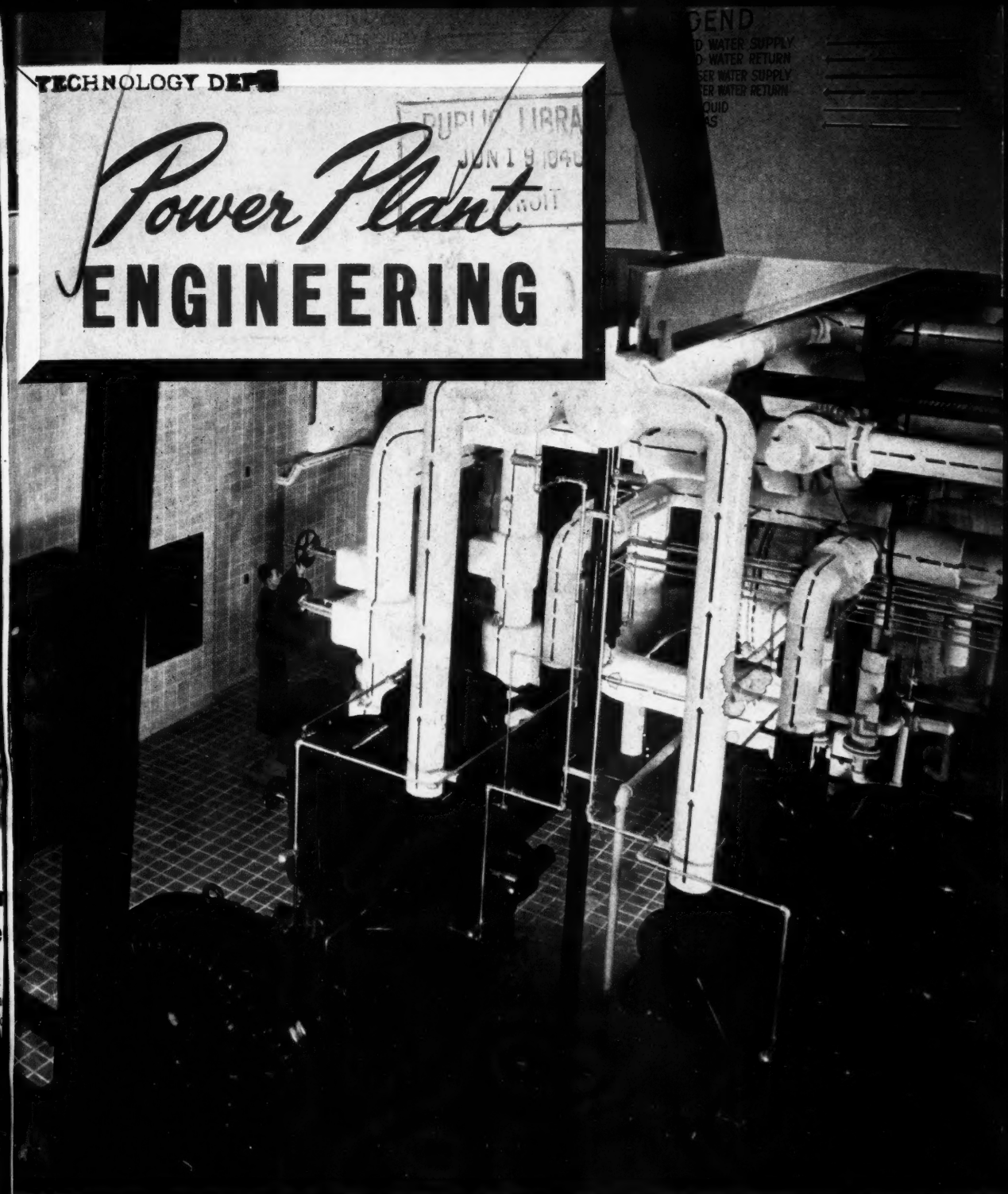
TECHNOLOGY DEPT

Power Plant ENGINEERING



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THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

JUNE • 1946

Features

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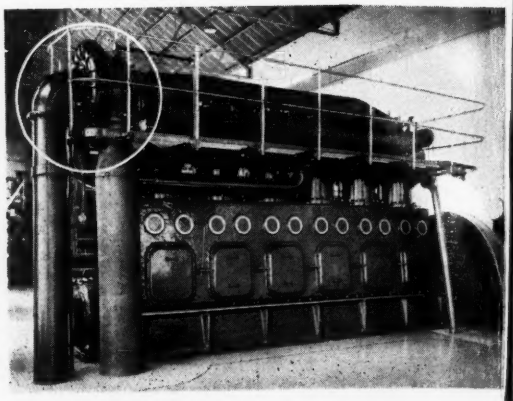
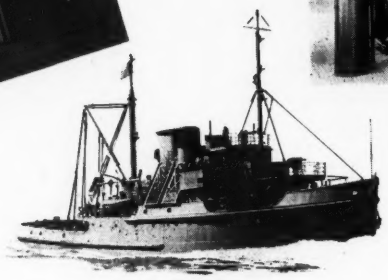
RECOGNIT

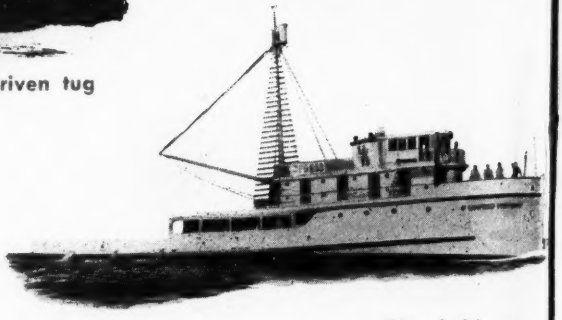
REA power station



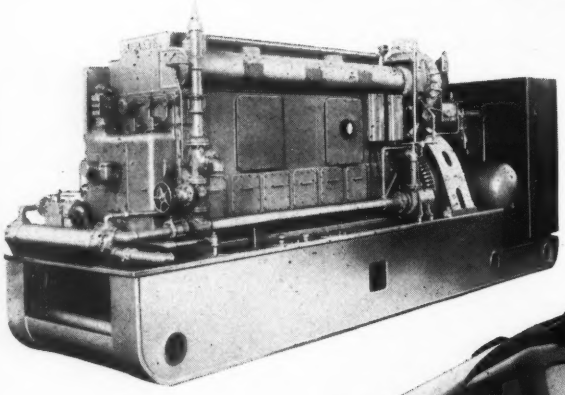
Pipe line pumping station



Diesel-driven tug

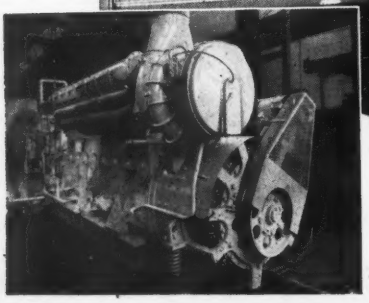


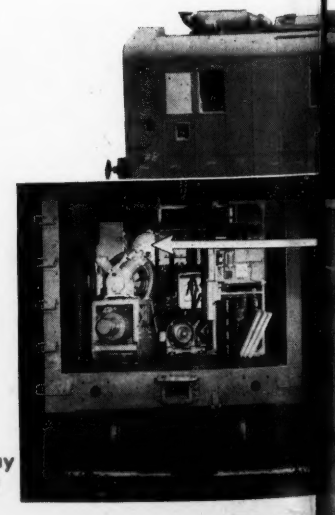
Diesel-driven tuna clipper



Package power plant

Diesel-electric mainliner





Mobile railway power plant

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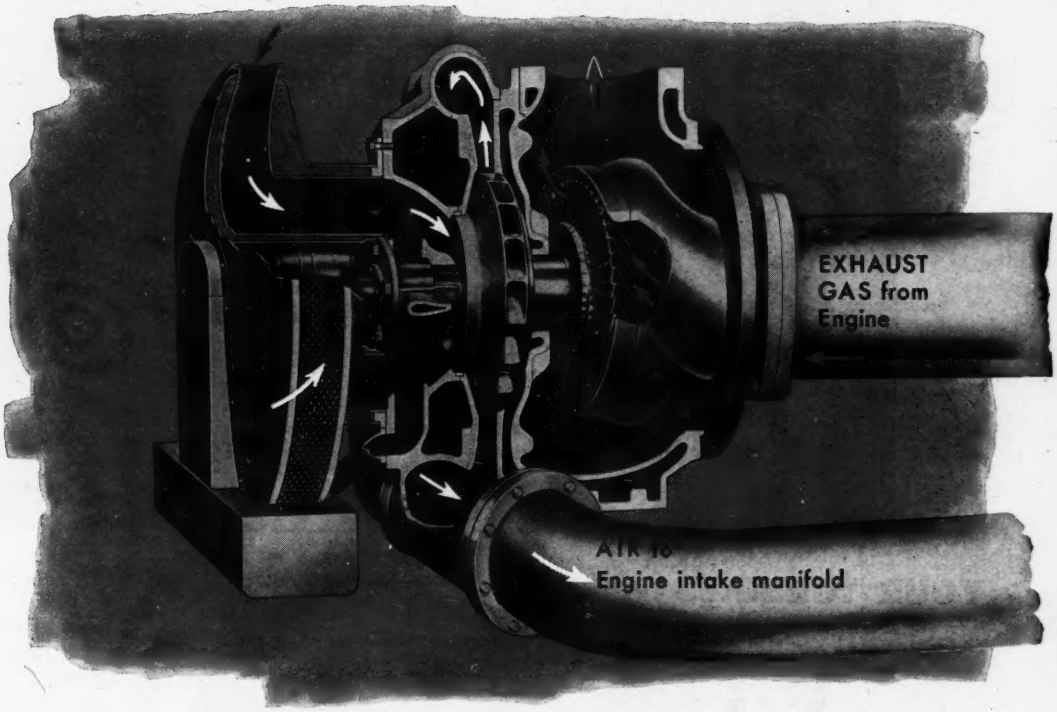

Turbocharged four-cycle Diesel engines have met with unparalleled success in widely diversified installations. Engine builders and users like their compactness and adaptability. They like the "plus" factor of turbochargers.

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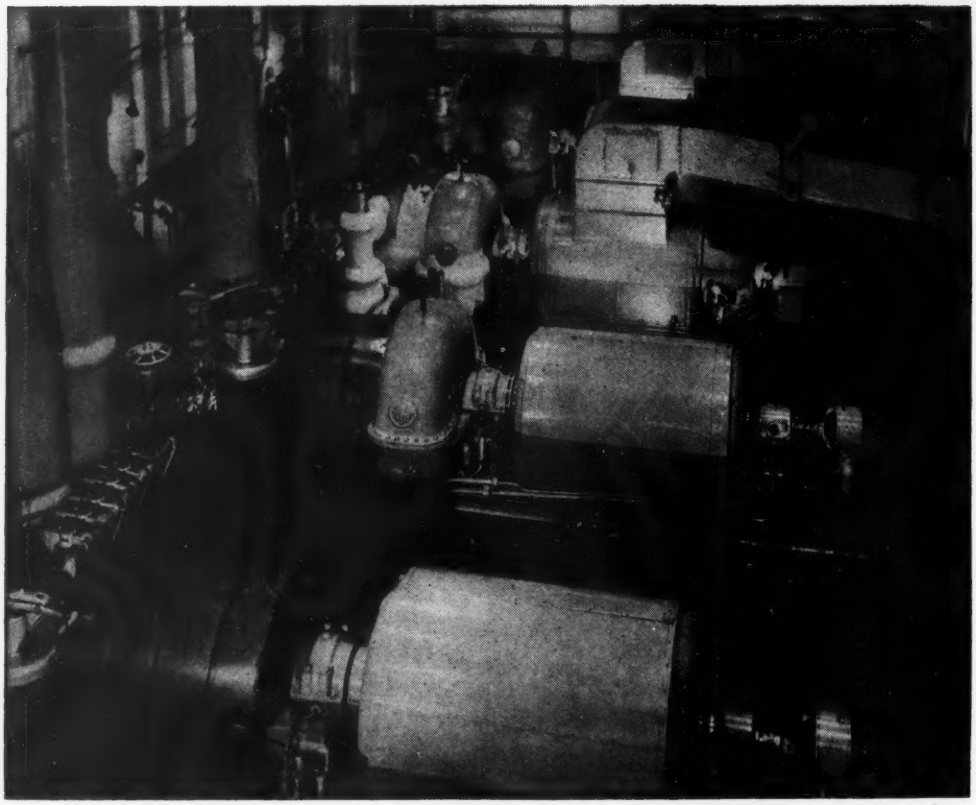

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ABC

Power Plant ENGINEERING

June, 1946

VOLUME 50—NUMBER 6

Cover: This refrigeration machine room, with 630 tons capacity for air conditioning and water cooling, is one of the show places in Bankers Life Co. building at Des Moines. Tinsley, McBroom & Higgins, architects. Hedrich-Blessing photograph.

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Jenkins PRACTICAL PIPING LAYOUTS 11

How to plan a DIESEL ENGINE FUEL OIL SYSTEM

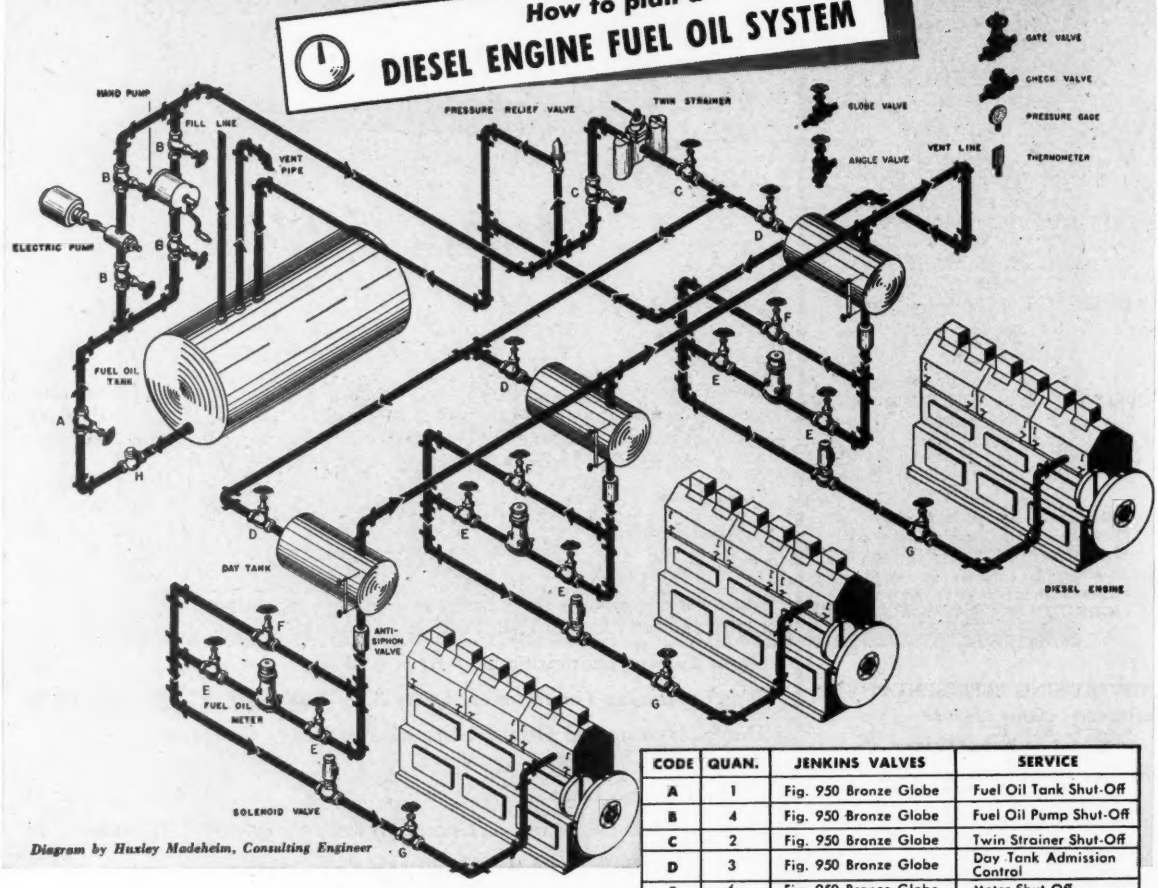

Diagram by Huxley Madeheim, Consulting Engineer

CODE	QUAN.	JENKINS VALVES	SERVICE
A	1	Fig. 950 Bronze Globe	Fuel Oil Tank Shut-Off
B	4	Fig. 950 Bronze Globe	Fuel Oil Pump Shut-Off
C	2	Fig. 950 Bronze Globe	Twin Strainer Shut-Off
D	3	Fig. 950 Bronze Globe	Day Tank Admission Control
E	6	Fig. 950 Bronze Globe	Meter Shut-Off
F	3	Fig. 950 Bronze Globe	Meter By-Pass
G	3	Fig. 950 Bronze Globe	Engine Shut-Off
H	1	Fig. 762 Bronze Swing Check	Suction Line

VALVE RECOMMENDATIONS
For details – and valves to suit varying conditions – see Jenkins Catalog

Elimination of hazards of leaking oil is a requirement of all building codes and safety specifications for fuel oil installations. This layout illustrates a Diesel Engine Fuel Oil System which will be approved under practically all codes now in effect.

With no direct exposure of the large isolated storage tank in the engine room proper, the principal danger of oil leakage is removed. Oil is pumped from the main storage tank to the individual 50-gallon Day Tanks that are provided with overflows to return excess oil back to the storage tank in the event of over-pumping. A pressure relief valve in the discharge line from the oil pumps returns the oil when excess pressure develops.

Control valves on each of the Day Tanks make it possible to fill them individually or in parallel.

Other types and pressure ranges of Jenkins Valves can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installation.

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Front Lines

ADDITIONAL DATA and statistics on metals and materials of the "occupied" and other European countries in the recent war years are daily becoming available for publication in *Mineral Trade Notes* of the U. S. Bureau of Mines, Department of the Interior. The November 20, 1945 issue, for example, contains data on lead and zinc and mercury in Italy during the war and descriptions of conditions of individual mines in that country. The most complete records that have been available on iron and steel in Sweden since the beginning of the war are also presented. In view of the much-discussed topic of atomic energy, it is of interest that prospecting and exploiting of radio-active minerals have been prohibited in Spain, Union of South Africa and Venezuela.

"STEADY EMPLOYMENT, if it can be attained, is economical. Steady operation is economical. Steady employment is socially important, and particularly in these times. The means to steady employment is this: those of us in business must (it is a *must*) produce to a consumption line rather than a buying line. I ask you to remember that; it is the whole kernel, the keynote." Richard D. Deupree, president, The Procter & Gamble Co., before the conference on General Management of the American Management Association.

THE D-P GLASS-METAL diffusion pump produces high vacua at the phenomenal speed of about 220 liters per second at 10^{-4} mm. Some models produce vacua at less than 10^{-5} mm at 25 C. It is adaptable to evacuation of cyclotrons, ultracentrifuges, vacuum spectrographs, metal evaporation systems. Various oils are used, such as Amoil-S and Octoil-S. The pump casing is of Pyrex, permitting observation of the operation of the pump. Adequate air cooling from a small fan or air line is required. The unit is sold without oil for $150.

IN THE SOUTH CHINA SEA, Japan lost the stolen oils of the Indies and with it her hope of victory, says the October issue of *The Lamp*. That hope was a daydream if there ever was one. How did Japan, with an oil production only one sixth to one quarter of ours, including what they stole, expect to get away with it? But, you will say, why worry about that now; we beat 'em, didn't we? True, but can't we in some way make the Japanese and the other nations of the world realize what saps they were to let themselves get pulled into a war with odds like that against them? Probably not, because the nationalism that breeds wars has nothing to do with facts or reason.

"LABOR TROUBLE is not necessarily a strike but it is the negative philosophy, thinking and opinions of the worker for management. If employees believe that top management is composed of profiteers whose only objective is to exploit labor with no interest in the employees except what they can get out of them, there exists a constant source of labor trouble that reflects itself in high operating cost and low profits. Too many people in top management believe they know what employees think. These opinions are generally formed by top management talking to the workers who know it is a good idea to tell management what they believe the executive wants to know. Another source is from the union negotiating committee who have sifted the information they want to pass along. Consequently, top executives in most companies do not have the correct facts upon which human relations policies, that will improve the quality of their personnel assets, can be formed."—John D. Corrigan of Corrigan, Osborne & Wells, Inc.

REMEMBER the recent discussion in *Front Lines* by Dan Gutleben and others about the hobby of collecting lore on covered bridges? Since that time a tremendous amount of information on covered bridges has turned up. According to W. A. S. Douglas, Ohio has 609 covered bridges, Pennsylvania 336, Indiana 202, Vermont 170. Minnesota has only one. Illinois has 23 of them, all given fond care, says Mr. Douglas. A recent report of the Illinois State Historical Society says they are all in good repair and in use.

MANY COMPOUNDS are stable at high temperatures, break down at intermediate temperatures and are again stable at ordinary temperatures. Using this principle, Dr. Farrington Daniels has developed a method of making nitric acid from the oxygen of the air, reports the Industrial Bulletin. Air is heated to 4200 F where some of its nitrogen and oxygen combine to form about 1.75 per cent of nitric oxide in the resultant gases. The gases are quickly quenched to preserve the nitric oxide, which is converted by the oxygen of the air into nitrogen dioxide and this, dissolved in water, forms nitric acid. Equipment is relatively small and economical.

THE I-40 JET ENGINE, which powers the P-80 Shooting Star, was installed in the fuselage of a B-24 for testing. This flying test cell had all the advantages of a wind tunnel with less cost, greater availability and capacity to carry the required test instruments. Other advantages over wind tunnel testing were acquisition of plane design and operating data.

ELECTRONIC HOT DOGS! At last! Just walk up to a machine that looks like a soft-drink or cigarette machine—they could even make it look like a juke-box, with colored lights and automatic record changer and everything—drop in the requisite coin of the realm, and out will come a freshly roasted hot dog, hamburger or grilled cheese sandwich. It's done by the high-frequency heating produced by an oscillator operated by specially-developed GE high-frequency power oscillator tubes—all a development related to radar. The machine has a glass front through which you can watch your dog getting the hot-foot. Nothing is said about an electronic mustard-squirter-onner but there must be one. Or even a raw onion, sliced fresh and applied by electronic methods.

WAR ASSETS CORPORATION has a proposal for giving small concerns first look at scarce equipment. The agency has received complaints that larger concerns are buying up equipment not yet available in the open market. Under the plan, small companies would get priorities if they could show that the equipment in question would enable them to produce at a break-even rate. The plan is not yet effective, at this writing, but in the circulation stage. There would be some red tape—e. g., proof that a concern is "small," etc. But if it's important to you to get equipment, maybe you can get behind the idea and give it a shove.

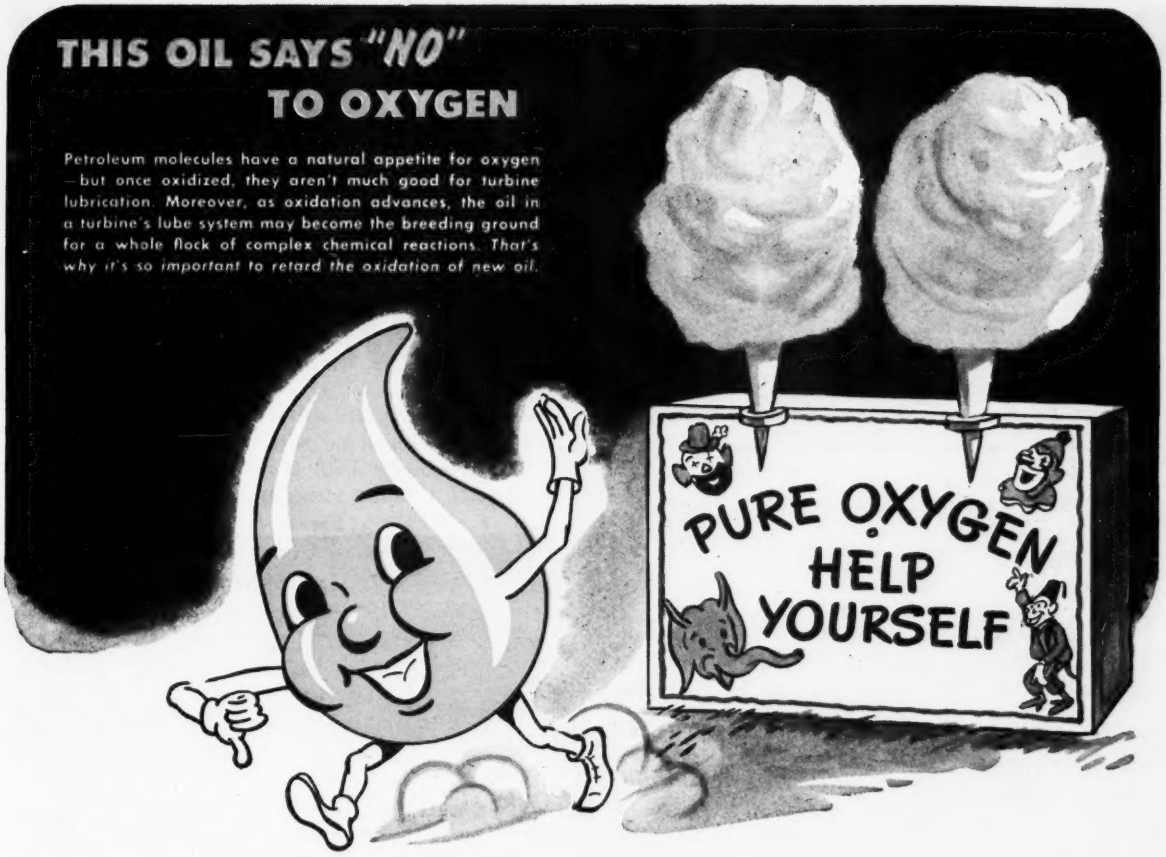
WHERE HYDROGEN is needed in high purity and small quantity, it can be produced from lithium hydride, says the *Industrial Bulletin.* It is easily transported and on contact with water rapidly releases hydrogen. It was used during the war to inflate balloons to carry radio antennae aloft from life rafts. A 5-lb can of lithium hydride releases as much hydrogen as a standard hydrogen cylinder weighing 140 lb.

TALKING with service men back from the European theater, it is alarming to hear so many of them speak well of the Germans and very critically of our allies, comments the Near Editor of *The Houghton Line.* The reasons for this, he points out, are clear: the Germans are just as smart now in ducking all responsibility for this war as they were after the first World War. It is natural that they should try to ingratiate themselves with the conquerors and stir up trouble between the allies. But to anybody who knows the historical facts of the past 25 years, to let the Germans get away with it is not only stupid but fatal. The world can't stand another war. "But there may be one," says the Near Editor, "if too many Americans are tricked into believing that our former enemies are now our friends and nice people, but our allies are second-rate characters who can't fight, won't wash and don't know how to live right. That's what a lot of our veterans are saying, and it worries me sick when I hear it. I heard it before, right after World War I and I know that it had a lot to do with making the second World War possible."

HYDROGEN PEROXIDE is now available in concentrations up to 90 per cent instead of the previous 35 per cent maximum. It is in effect a new self-contained source of energy and oxygen, which, when released leaves no residues or corrosive toxic gases. The Germans used it to fuel V-weapons, rocket fighter planes and super-submarines, according to the *Industrial Bulletin,* but only in 85 per cent concentration, which was relatively impure. As an energy source it provides, on decomposition, steam and oxygen to drive various types of engines. The oxygen from the peroxide may be used to burn either customary fuels, such as a type of Diesel fuel in the Walther submarine engine, or special chemicals such as hydrazine hydrate. The Walther engine powered submerged submarines at speeds up to 25 knots, much faster than most merchant ships. What new applications will be made of these new developments is a challenge to designers. The chemical uses of high-test peroxide are still essentially unexplored. The price of the 90-per cent solution is only slightly above that of the concentrations now common. A pilot plant is now operating and a full-scale plant was scheduled to be completed this spring.

RADAR has settled down to business on its first big peacetime job—the task of protecting shipping on the 185-mile Baltimore-Norfolk night run of the Old Bay Line, oldest steamship company in the United States. The new unit aboard the City of Richmond provides navigational aid and anti-collision protection in any weather and zero visibility for from 100 yards to 32 miles of the ship in every direction. The new installation is of the continuous plan position indicator type. The picture is shown on the disc-like face of a 7 in. cathode ray tube—similar to those used in television—mounted in a small cabinet on the bridge. Water surfaces are dark, while any obstruction—ship, buoy, shoreline, etc.—is indicated in a bright fluorescent pattern. Ships are shown graphically and shorelines appear as on a map. Readings are taken at three ranges—at radii of two, eight and thirty-two miles.

FOR SOME TIME we have been telling anybody who would listen that we expected to see an atomic power plant, designed specifically for the generation of electricity, built much sooner than all the wiseacres thought possible. We said within a year or so. Well, the Manhattan District has been allotted $2,500,000 to build such a plant at Oak Ridge, Tennessee. It will be based on the research of Dr. Farrington Daniels at the Metallurgical Laboratory of the University of Chicago and the atomic energy pile to be erected will be called the Daniels pile. Monsanto Chemical Co. will have over-all authority for design, construction and operation of this first atomic power plant and has assigned Dr. Charles A. Thomas, vice-president and technical director, to the project. Allis-Chalmers Mfg. Co., General Electric Co. and Westinghouse Electric Corp. will also have a part in the work. The plant may be finished this year if materials and labor can be made available.


THIS OIL SAYS "NO" TO OXYGEN
Petroleum molecules have a natural appetite for oxygen—but once oxidized, they aren't much good for turbine lubrication. Moreover, as oxidation advances, the oil in a turbine's lube system may become the breeding ground for a whole flock of complex chemical reactions. That's why it's so important to retard the oxidation of new oil.
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HELP YOURSELF

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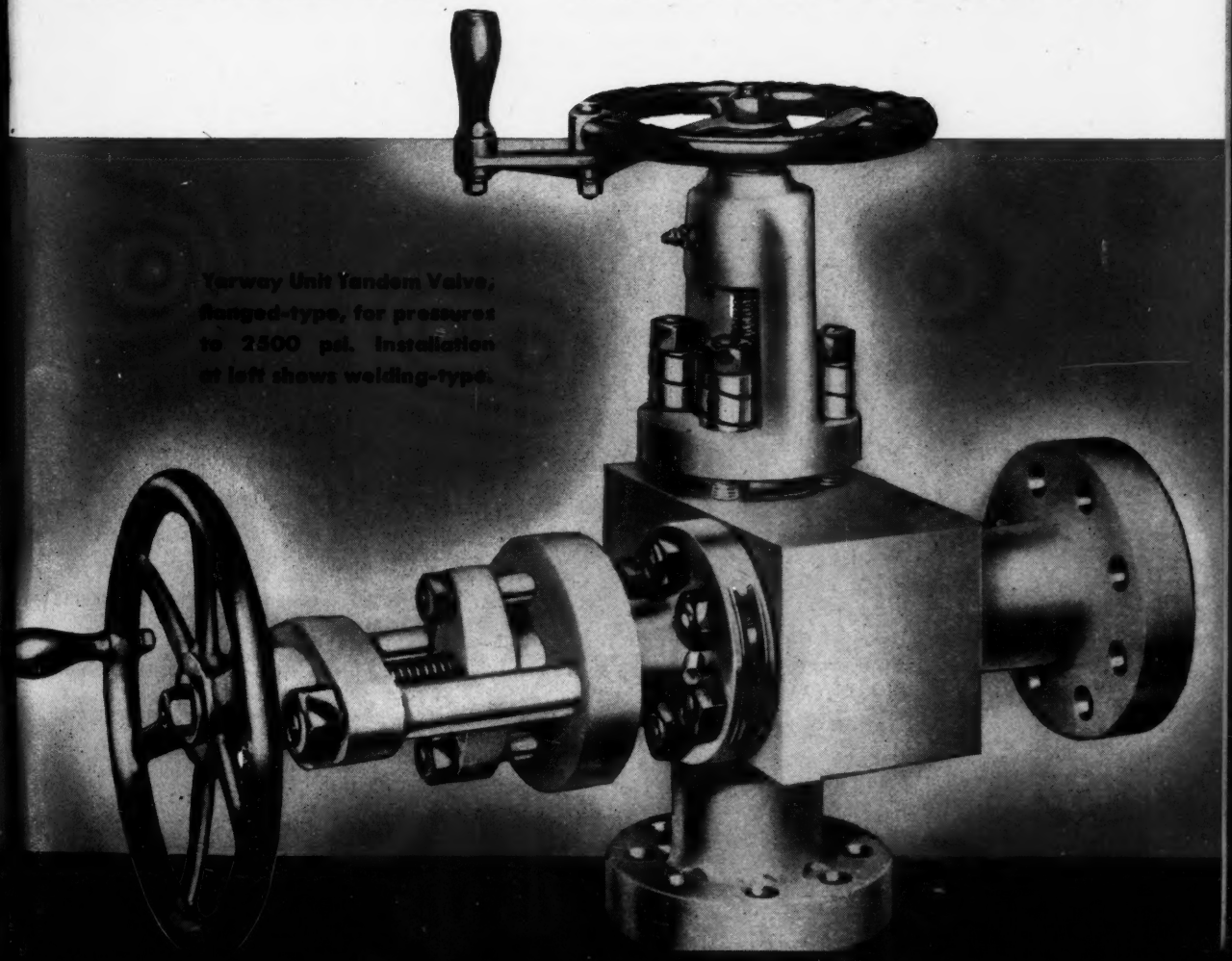

Yarway Unit Tandem Valve, flanged-type, for pressures to 2500 psi. Installation at left shows welding-type.

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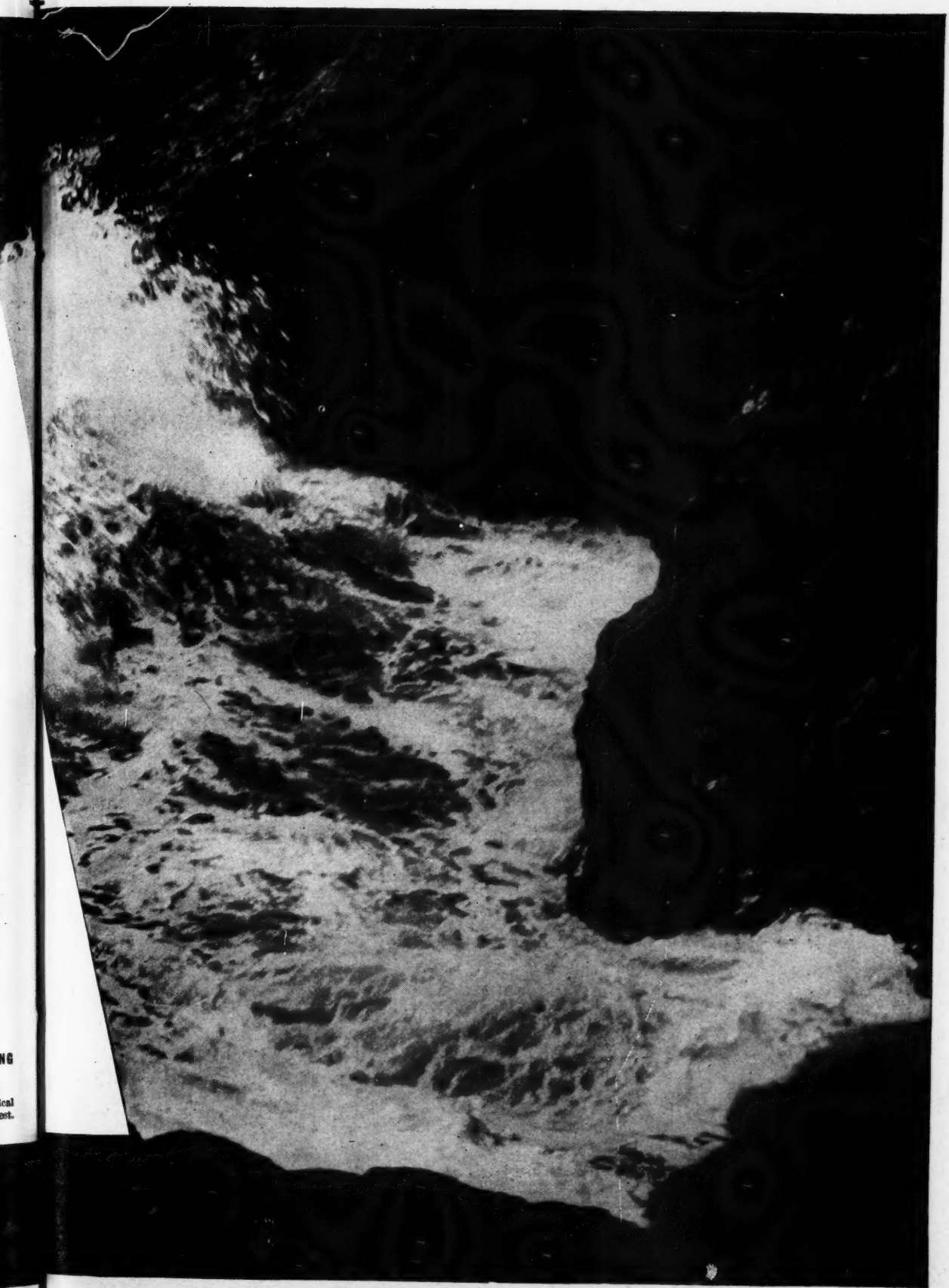
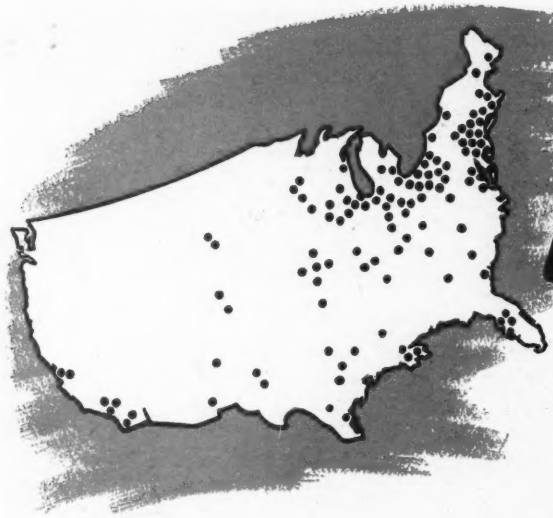
INDUSTRIAL WASTE TREATMENT

Cover photograph from the *Betz Indicator*, a monthly publication devoted to the chemistry and practical applications of water conditioning. The *Betz Indicator* will be mailed without charge at your request.





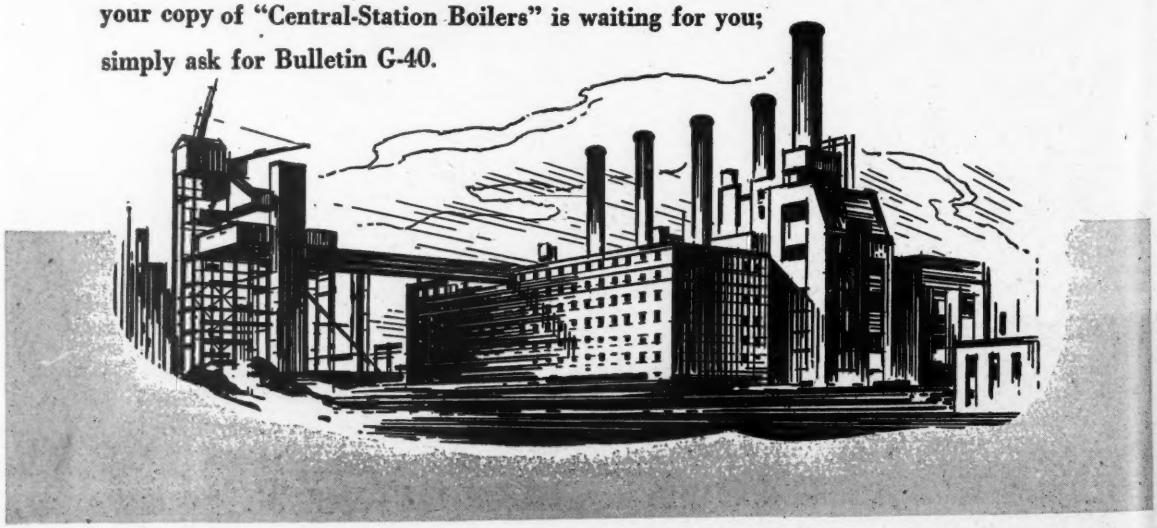
165 Central ...highlighted in

HERE'S interesting and helpful data on the latest B&W central-station boiler installations throughout the nation.

Current boiler designs are presented in detailed drawings, with capacities, pressures, temperatures, firing methods, and other pertinent information conveniently tabulated.

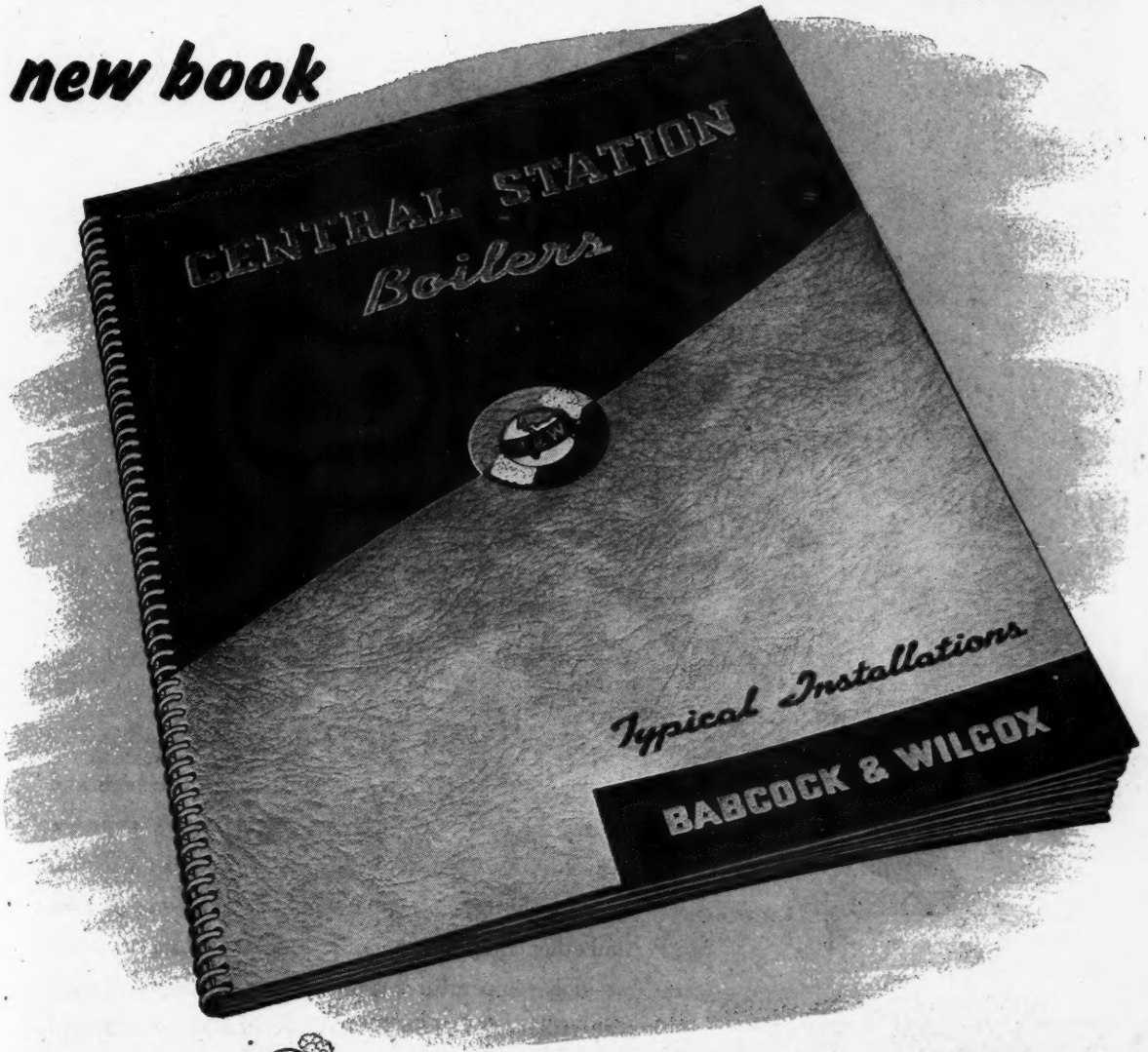
Twenty years of boiler and furnace development is traced from the early use of partial water-cooling of refractory furnaces to the B&W performance standards of today. It includes applications to boilers used for the comparatively short transition period when topping became economically desirable and boilers were designed to fit in available space in existing buildings. Examples show how standardization has been accomplished in the smaller boiler unit designs, and indicate a trend to standardization in units of the larger capacities.

B&W is ready at any time to apply the diversified experience typified in this booklet to the solution of your specific steam power problems. In the meantime, your copy of "Central-Station Boilers" is waiting for you; simply ask for Bulletin G-40.



Station Boiler Installations

new book



Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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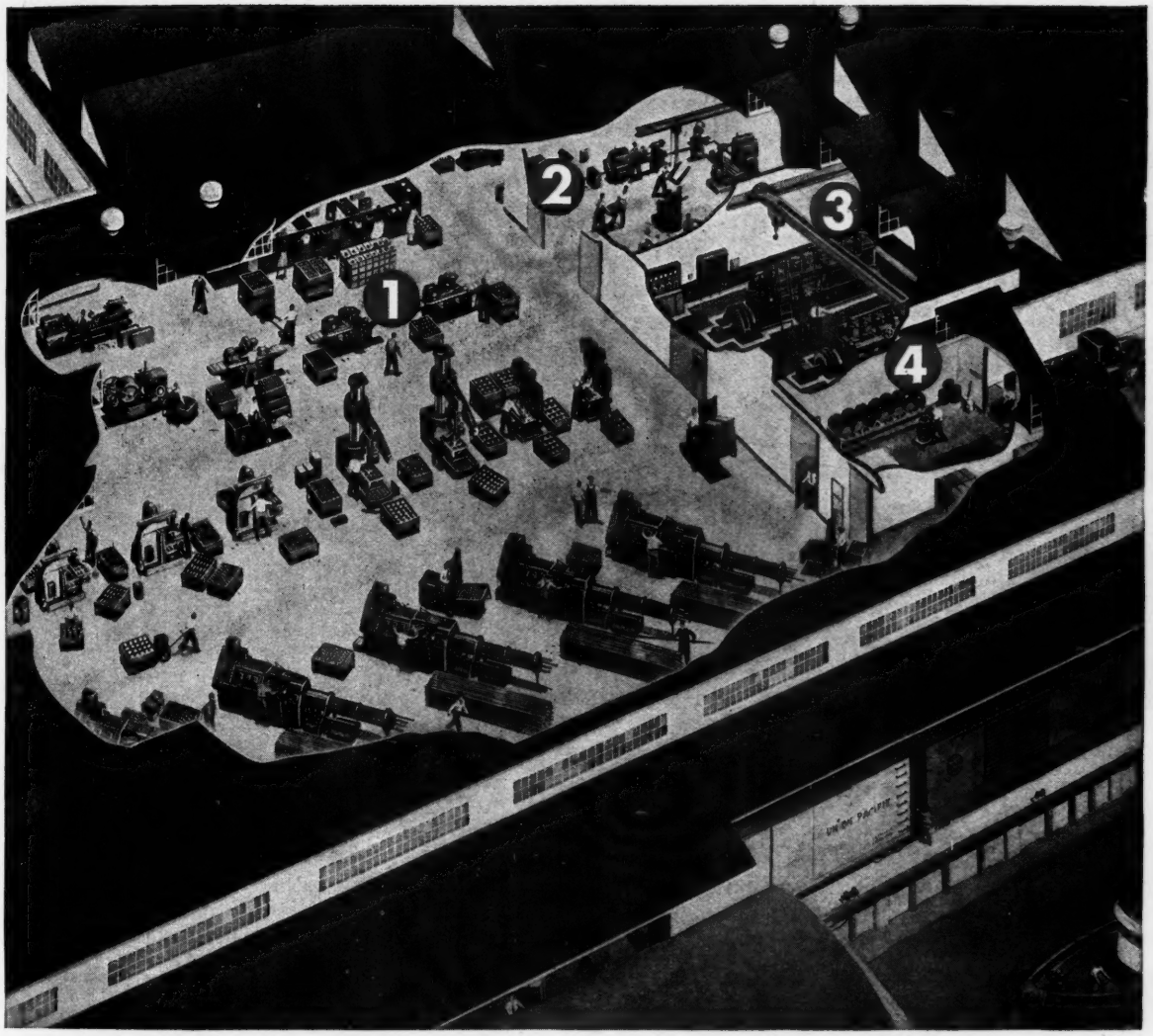

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Vital factor in any production picture is steady, uninterrupted machine operation. Socony-Vacuum Correct Lubrication assures peak machine efficiency and greater overall production.

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By reducing friction losses, Socony-Vacuum lubricants cut power waste. In the power plant, correct oils keep turbines, Diesels, steam engines and air compressors operating at peak efficiency.

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Quality lubricants stand up longer, give maximum protection with minimum consumption. Ultimate lubrication costs are lower. Get these profits for your plant.

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Socony-Vacuum Oil Company, Inc.

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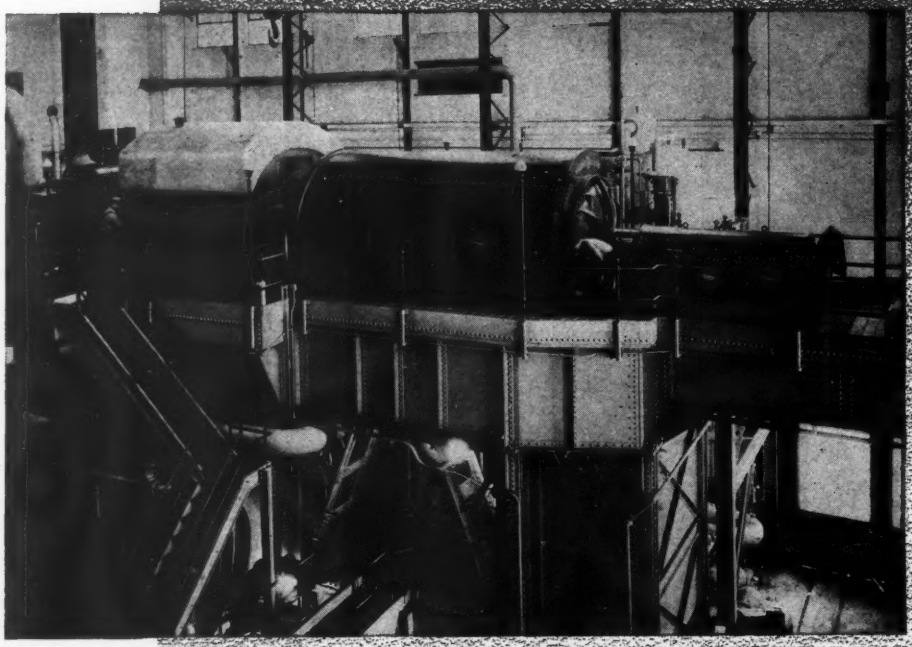

FREE OF DIRT AND FREE OF WATER . . .

A DE LAVAL Oil Purifier in this power plant keeps the lubricating oil clean. And "clean" means *really* clean — free of dirt and free of condensate or other moisture.

When purifying oil, it is not enough to remove solid contaminants only. Water, in the form of condensate or from any other source, can do far too much damage in too short a time to allow it to remain in the lubrication system. A De Laval centrifugal removes such water by centrifugal force, continuously discharging it. Since the dirt is simultaneously separated from the oil and stored outside of the zone where purification takes place, the oil is restored to a condition most nearly comparable to that of new oil, and the turbine — or any other power unit — receives maximum protection.

De Laval Oil Purifiers have long been used by America's leading power plants. 94 per cent of the largest plants in the country have installed De Laval Oil Purifiers for the purification of either turbine oil or insulating oil.

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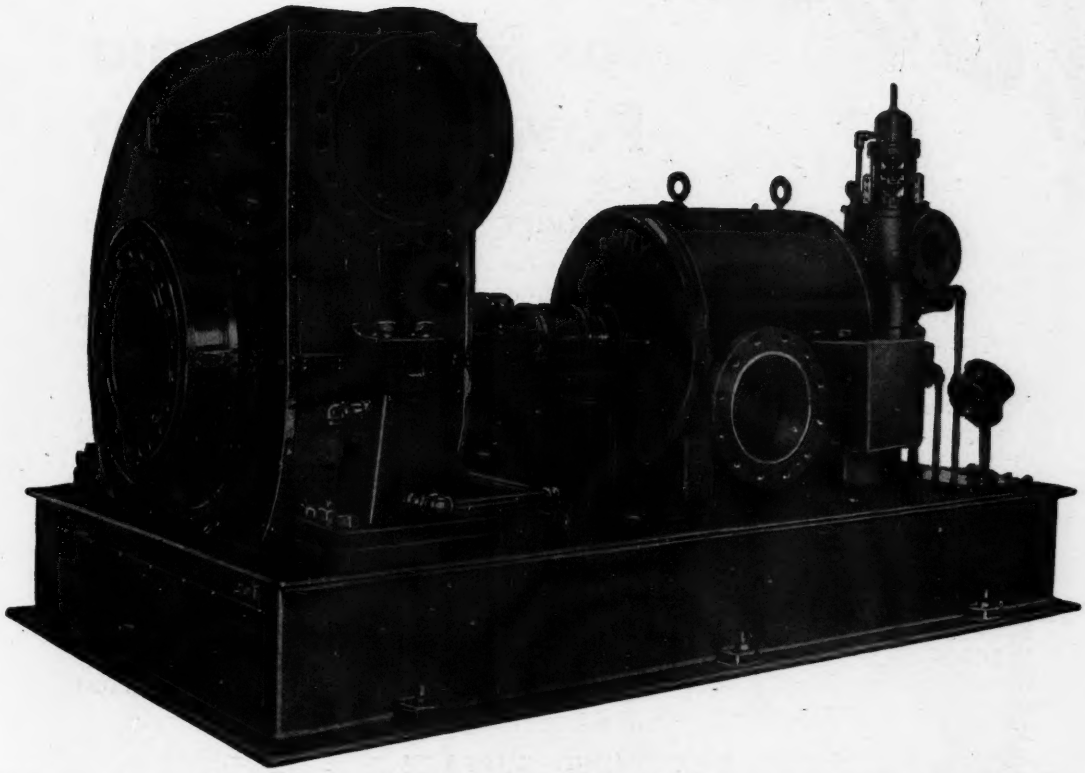
DE LAVAL
LUBRICATING OIL PURIFIERS

The TERRY TURBINE



MULTI-STAGED TURBINES CAREFULLY ENGINEERED TO MEET YOUR REQUIREMENTS

Each Terry Multi-staged Turbine is individually designed and proportioned in accordance with the plant conditions and requirements.

A typical unit is shown above direct connected to a blower. This turbine is rated 1200 H.P. at 6100 R.P.M. It is equipped with six stages and operates condensing. The governor is of the oil relay variable speed type. The lubrication system provides flood lubrication to the turbine and blower bearings.

If you have an application for a turbine — single staged or multi-staged — geared or direct connected — standard or special — in sizes up to 2000 H.P. — talk it over with Terry.

T 1162

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

1,600,000 LB. STEAM

for Pennsylvania Power and Light

SERVICE

Pennsylvania Power & Light Company, under its progressive policy of continually extending and improving electric service throughout central eastern Pennsylvania, has started construction on a new steam-electric station near Sunbury. This plant, when completed, will be the largest anthracite-fired installation in the country.

SUNBURY STEAM-ELECTRIC STATION

Four new Foster Wheeler steam generators will each supply a continuous capacity of 400,000 lb. steam per hour. These are the largest steam generators to be arranged for direct firing of pulverized anthracite. Unburned carbon loss will be held to a minimum by opposed firing and by reburning fly ash on the furnace floor. Eight Foster Wheeler ball mills – two per unit – will serve these four steam generators.

PULVERIZED ANTHRACITE

Systems for the direct firing of pulverized anthracite were introduced by Foster Wheeler in 1935. The first central station order followed in 1945. Units which were effectively burning the very small sizes of anthracite during this ten-year interval demonstrated their value for central station use.

EXTENDED SURFACE

Extended surface tubes in the convection section of each Sunbury unit provide steam generating surface in less space than the conventional bare tube arrangement.

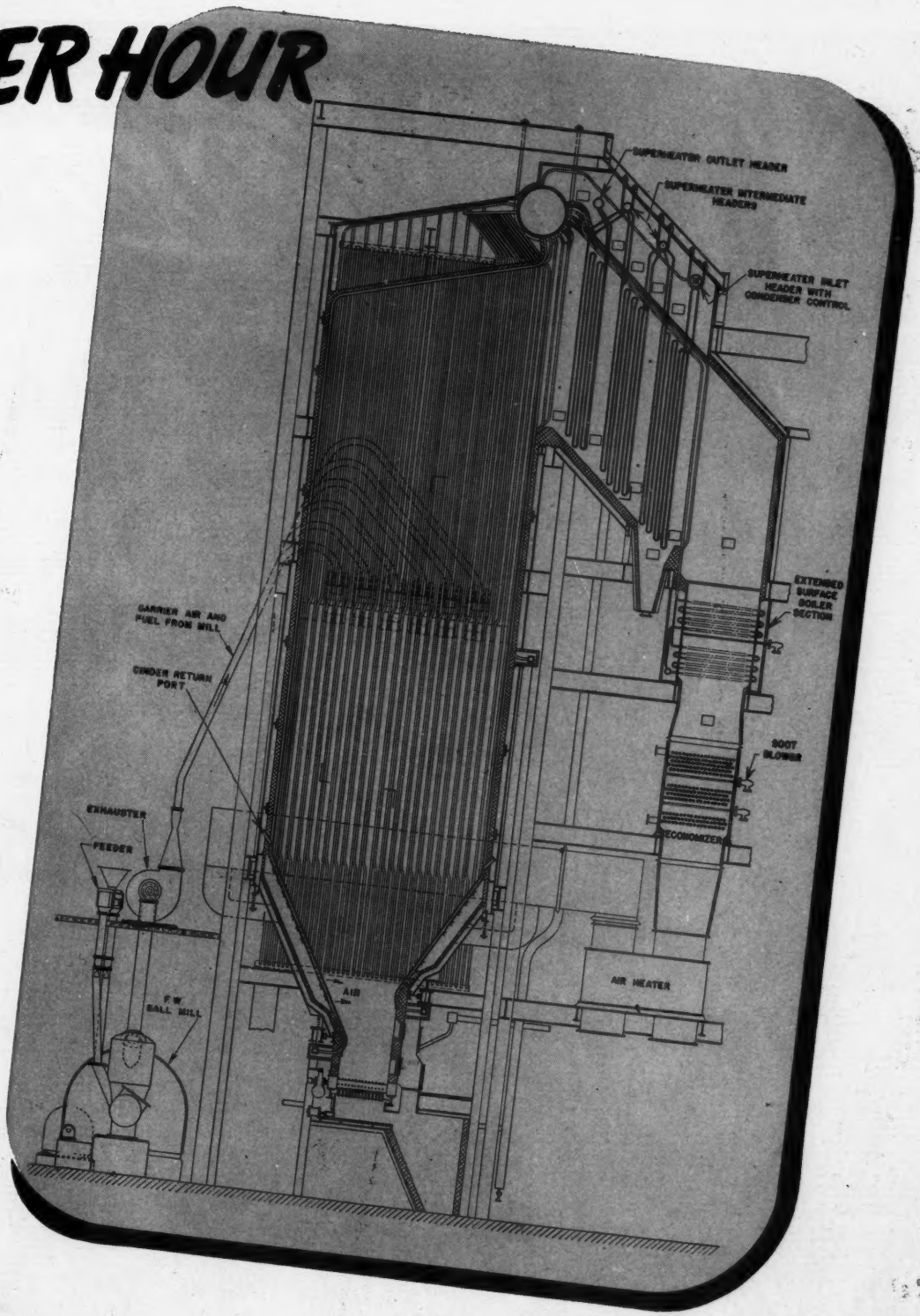
FOSTER WHEELER CORPORATION • 165 Broadway, New York 6, N. Y.

SUNBURY

Number of units	4
Steam Capacity	400,000 lb. per hr.
Design Pressure	1,500 lb. per sq. in.
Superheat Control Range	from 250,000 lb. per hr.
Final Steam Temperature	955 deg. F.
Fuel	Pulverized Anthracite

FW FOSTER

PER HOUR



WHEELER

Vogt Steam

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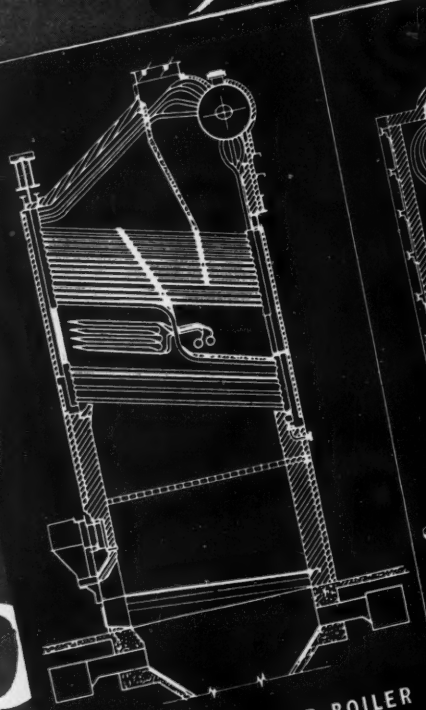
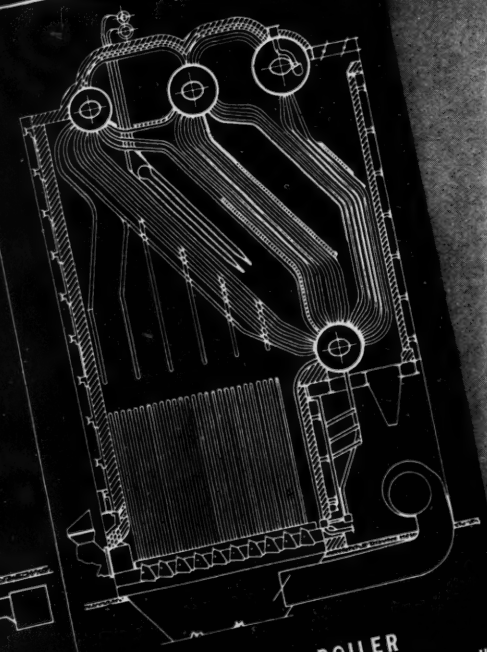
HENRY VOGT MACHINE CO., Inc.



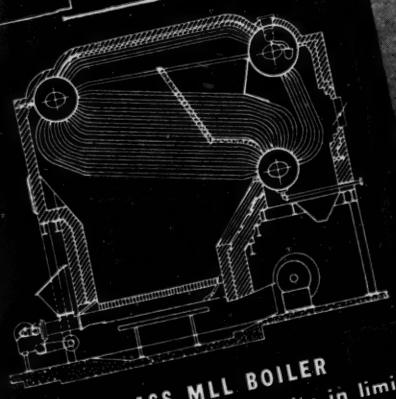
SECTIONAL HEADER BOILER

Sinuous forged steel headers feature this straight tube, cross-drum type generator. Staggered tubes achieve high heat transfer rate and insure efficient operation.



CLASS LE BOILER

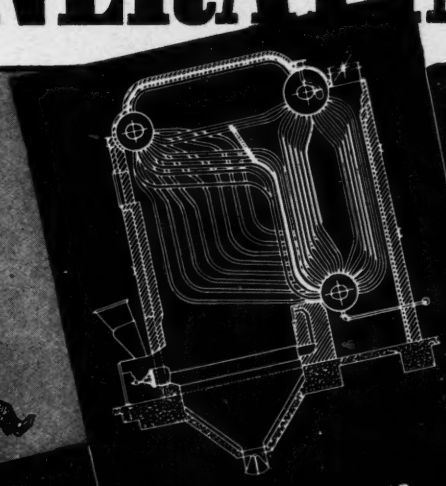
Unsurpassed for quick steaming at all ratings, this four drum, bent tube type will carry high overloads with high efficiency.



CLASS MLL BOILER

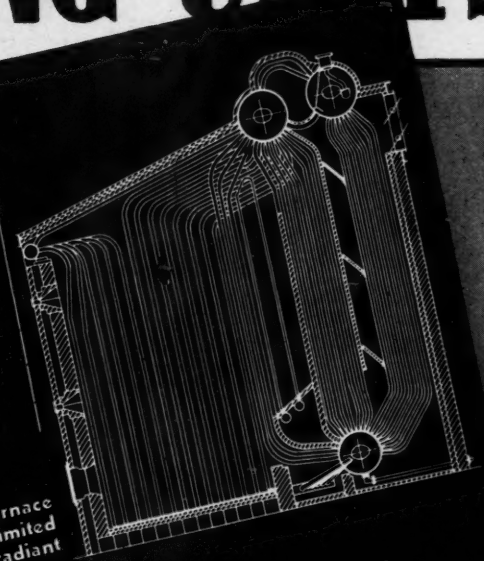
Provides maximum capacity in limited headroom. Widely used in industrial plants, institutions, etc., having moderate processing or power loads, and for heating.

GENERATING UNITS



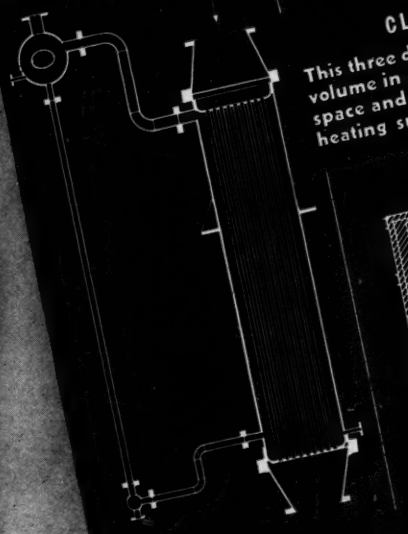
CLASS VL BOILER

This three drum design has large furnace volume in a unit which occupies limited space and provides high ratio of radiant heating surface.



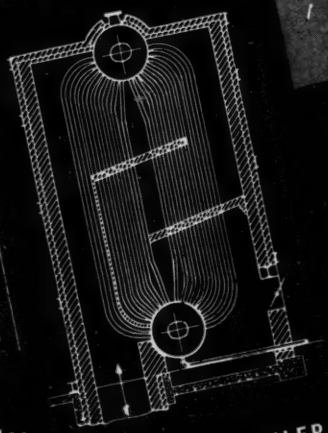
CLASS VR BOILER

An efficient, high-duty unit with water-cooled furnace for suspended fuel firing, such as powdered coal, oil, or gas.



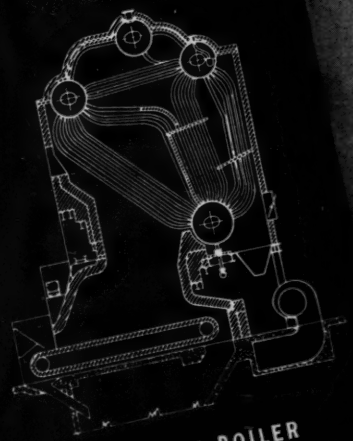
REFINERY WASTE HEAT GENERATOR

Shell and tube type designed to utilize high temperature gases from refinery processes such as those from catalytic units.



WASTE HEAT BOILER

A water-tube type which utilizes the heat in waste gases as produced by numerous industries. Designs will accommodate gases having high dust content.



CLASS M BOILER

This four drum, bent tube unit has the steam drum above the water level and delivers steam with 150-180 superheat.

1000 WEST ORMSBY STREET
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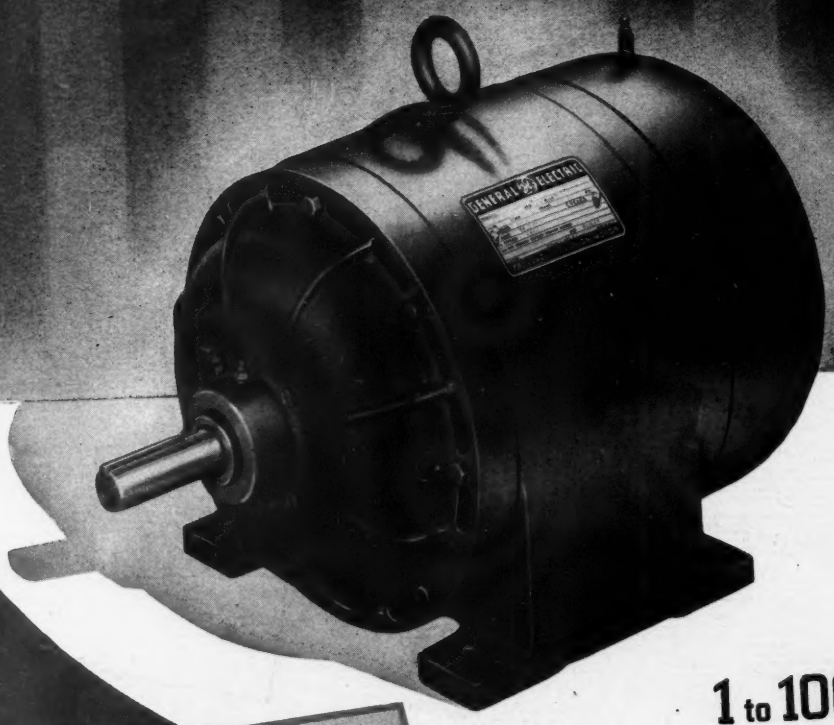
GENERAL ELECTRIC Announces



1 to 1000 hp

COMPLETE ENCLOSURE FOR PROTECTION AGAINST DIRT, DUST, AND WEATHER

NEW

Totally Enclosed

TRI/CLAD MOTORS

REG. U.S. PAT. OFF.

In 1940, G.E. introduced the Tri-Clad open motor—with emphasis on the feature that industry wanted most in a motor, *protection.* Since then, more Tri-Clads have gone into service than any other integral-horsepower motor.

Today, we are ready with a new line of Tri-Clad motors—*totally enclosed, fan-cooled motors*—built on Tri-Clad design principles in both standard and explosion-proof types.

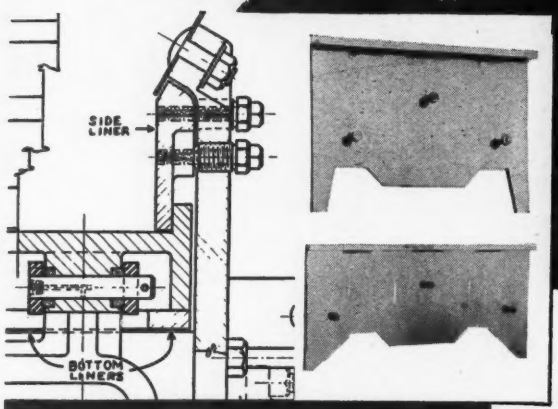
We believe that these are industry's most dependable motors. They are designed specifically for use in many adverse atmospheres—in iron dust, outdoors, in hazardous areas, and chemical atmospheres. Their scope of application is as wide as the field of industrial motor use. Safeguarded against most sources of motor damage, their longer life and lower maintenance will make them economical motors for use on almost every job. *General Electric Company, Schenectady 5, New York.*

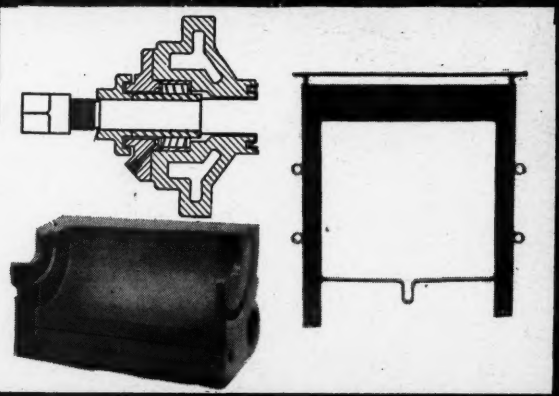
GENERAL ELECTRIC

TRI CLAD MOTORS

Contribu

HØFFMAN





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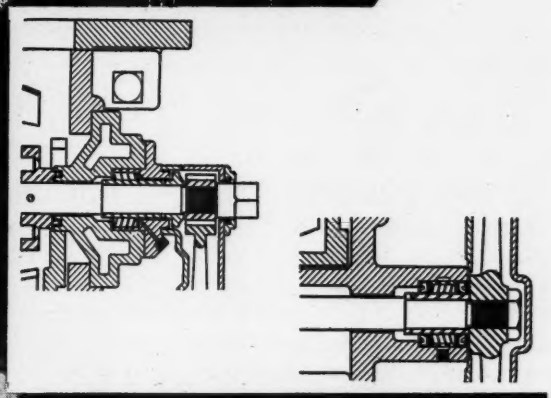

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OFFICES: Marquette Building, Detroit, Mich. Bell Building, Chicago, Illinois
154 Nassau Street, New York City Twenty-Two Marietta Bldg., Atlanta, Ga.

Agents in industrial centers

STEAM COSTS

WITH IRON FIREMAN PNEUMATIC

1

EFFICIENT COMBUSTION

Thousands of cost records demonstrate Iron Fireman coal saving. More efficient utilization of fuel is due to Iron Fireman's three fundamentals: (1) Positive control of fuel feed and distribution. (2) Positive control of air distribution and diffusion. (3) Positive control of fuel-air ratio.

2

QUICK PICK-UP

The Iron Fireman Pneumatic Spreader stoker is extremely sensitive to load demands. Its unusual flexibility makes this stoker an outstanding performer where power, heating, or processing loads are subject to wide fluctuation. Close automatic adjustment to the load is an important fuel-saving factor.

3

BURNS LOW-COST COAL

The Iron Fireman Pneumatic Spreader stoker not only saves tonnage by Iron Fireman's more efficient combustion, but cuts the cost per ton by using low grade coals. Burns efficiently the small sizes and low ash fusion coals as well as subbituminous and lignite.

4

HAS OWN CONVEYING SYSTEM

The Iron Fireman Pneumatic Spreader stoker does not require costly coal handling equipment. Its conveying system carries fuel from main bunker to boiler (upper right). Coal can be transferred by this means from basement bunkers to boilers on the first or even the second floor above.

5

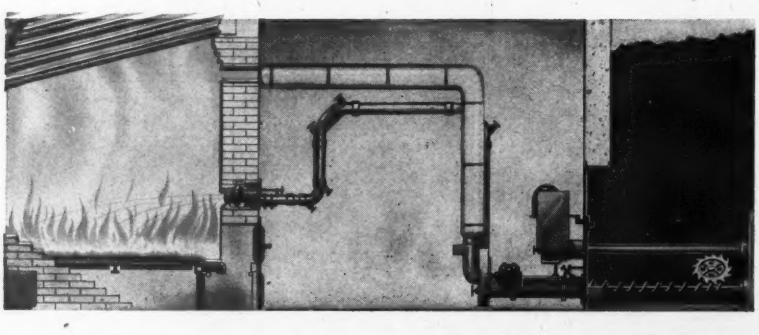
ECONOMICALLY INSTALLED

The Iron Fireman Pneumatic Spreader stoker requires a minimum of boiler-room alteration. Both the undergrate air and the coal feed nozzles can be introduced at front, rear, or sides of boiler—permitting easy adaptation to almost any boiler-room layout. Installation supervised by Iron Fireman.

6

LOW MAINTENANCE COSTS

No moving parts are subject to furnace heat; all mechanism is readily accessible for inspection and maintenance. Patented long-life grates are protected by constant air currents diffused through a coating of ash which is permanently maintained even on dump grates.



How the Iron Fireman Pneumatic Spreader Stoker Operates . . .

The Iron Fireman Pneumatic Spreader Stoker meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by a pneumatic conveyor and delivered to the furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat fuel.

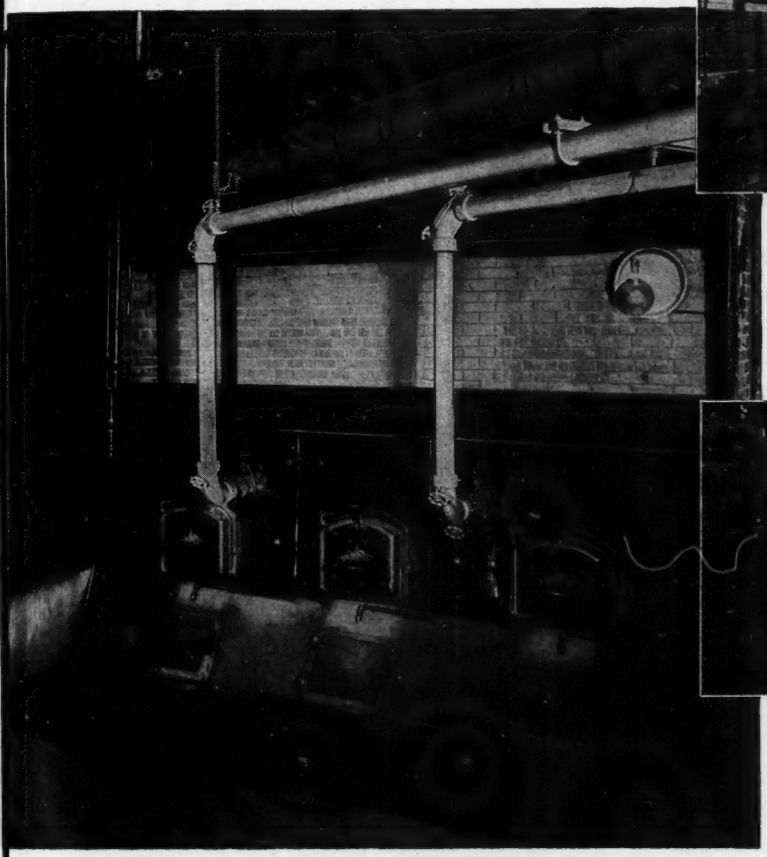
HEAVY DUTY AUTOMATIC COAL STOKER

IRON

THE IRON FIREMAN

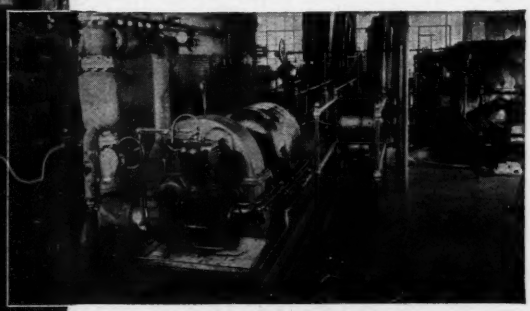
CUT SIX WAYS

SPREADER STOKER



FEEDS FROM MAIN COAL BUNKERS

Pneumatic conveyors carry coal a distance of 30′ in the W. L. Douglas plant. Coal pick-up section (below floor level at rear) takes coal from bunkers and transfers it to pneumatic conveyor pipes.



STEAM POWERED GENERATING PLANT

Steam is used for power, processing, and heating in the W. L. Douglas plant. Shown above is the power plant with both turbine and engine-driven generators.

Iron Fireman Pneumatic Spreader Stoker in the plant of W. L. Douglas Shoe Company, Brockton, Mass.

This clean, uncluttered boiler front in the W. L. Douglas Shoe Company plant is a typical Iron Fireman installation. The two pipes which are inserted through the boiler front near the fire doors are the fuel-conveyors which, through adjustable nozzles, spray the coal over the grate area. Hot gases which are used for preheating and conveying the coal are withdrawn from the combustion chamber through the insulated pipes visible at the top of the picture. This installation has increased plant efficiency, and reduced firing costs, according to Mr. C. S. Winchester, Chief Engineer.

WHAT ABOUT YOUR BOILER ROOM?

A survey in your plant, made without cost or obligation to you, will show you what Iron Fireman stokers will accomplish in your boiler room. Iron Fireman's nation-wide engineering, sales and service organization has had experience with every size and type of firing job. For such a survey and literature address: Iron Fireman Manufacturing Company, 3050 West 106thStreet, Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada.

FIREMAN

FOR POWER PROCESSING AND HEATING

Scovill Tube News

Vol. 4 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 2

Resistance to Erosion-Corrosion

It is characteristic of condenser tube alloys to form protective films of corrosion products which greatly reduce further attack. Some alloys develop continuous, insoluble, adherent, non-porous, self-healing films that are more resistant to erosion than others. Such alloys are selected for operating conditions suspected of accentuating the causes of tube erosion-corrosion. Aluminum Brass and Cupro-Nickel tubes have been found to have very high resistance to this type of attack. In some instances, however, the conditions are inherently so severe, even after all known practical remedies have been applied, that tube life of the most resistant alloy is short because of rapid and repeated destruction of protective surface films.

Mechanism of Erosion-Corrosion

The term Erosion-Corrosion has been selected to describe the type of attack generally discussed under the names of impingement attack, inlet-end corrosion, and air attack. Any continual abrasion of the tube surfaces by water containing entrained air or suspended solids, tends to break down, and prevent the formation of the protective film over the metal surfaces, thus exposing the clean metal to the progressive corrosive action of the circulating water. The attack is, therefore, combined erosion-corrosion — erosion removing the protective film, allowing subsequent corrosion of the clean metal surface. The seriousness of this action, which is a mechanical breakdown of the film, is dependent on the velocity of the water, the percent and size of entrained air bubbles, the presence of abrasive suspended solids and the composition of the tube alloy.

The attack may be localized at the inlet ends of the first pass (Fig. 1) or might extend over the whole length of the tube (Fig. 2) due to general erosion-corrosion of the metal.

The result of the action is a very irregular roughening and thinning of the tube wall.

In some cases the attack is concentrated in specific zones in the water box of a condenser, indicating that the causes are due to factors in the hydraulic cycle. Sometimes the occurrence of a rotating motion of the water in the inlet water box tends to form a low pressure area resulting in air bubbles of critical size collecting in the center of rotation. Attack is more severe on the tubes delivering this portion of the water. Other factors also result in localized tube failures; however, most failures of this type suggest a maintenance and routine inspection of the entire hydraulic system,

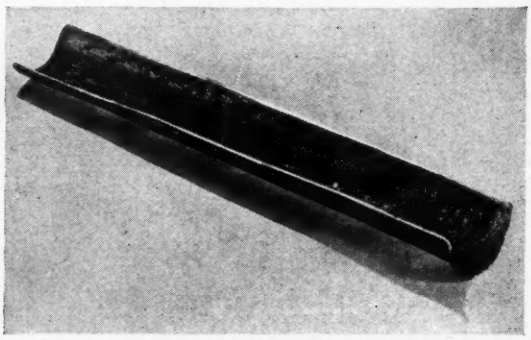


Fig. 1. Inlet End Erosion-Corrosion

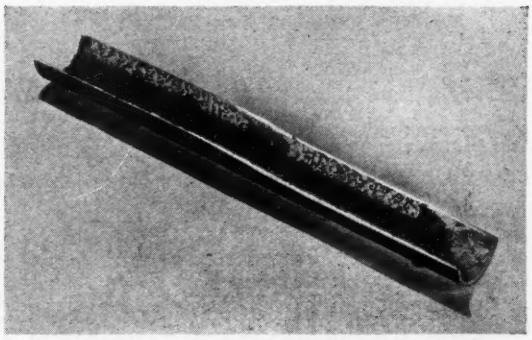


Fig. 2. General Erosion-Corrosion

starting at the intake water canal in order to determine the true cause of premature tube failure due to erosion-corrosion.

Mechanical Factors Contributing to Erosion-Corrosion

Air in the circulating water is in general the most direct cause of erosion-corrosion; however, any condition which creates air bubbles in water is a possible source of trouble. The source of bubbles may be from air entrained mechanically or from dissolved air released at low pressure areas or by turbulence. If adequate attention is given to the elimination of the source of released or entrained air, erosion-corrosion will be kept at a minimum. Some of the elements contributing to erosion-corrosion, that should be inspected for pressure differentials promoting the formation of pockets, turbulence and eddies, are included in the following list:

1. location of intake
2. pump suction bells
3. pump suction lift
4. non-vented air pockets
5. position of valve bonnets
6. pump thrust rings
7. pump gland seal
8. wear on pump blades
9. streamlining of reinforcing ribs, injection nozzle, inspection doors
10. venting of water boxes
11. projection of tube ferrules

Streamlining in the hydraulic system will minimize possible release of air. Belling of the tube ends to a proper hydraulic radius helps minimize localized turbulence (Fig. 3).

In general, erosion-corrosion depends on the presence of air or suspended abrasive solids in water

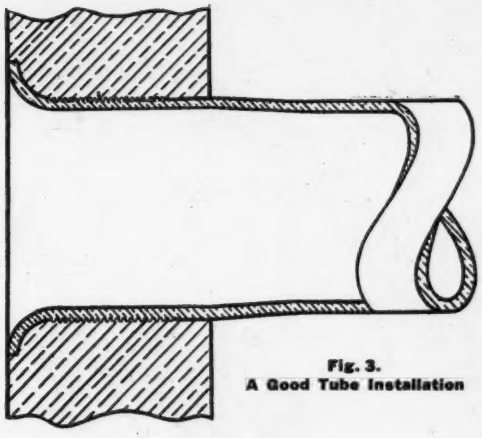


Fig. 3.
A Good Tube Installation

circulating at high velocities and is caused by conditions outlined above. For these conditions Cupro-Nickel or Aluminum Brass tubes normally would be considered most suitable.

Three Scovill Services

Service in Manuals, of which "Scovill Tube News" is a sample, consists of literature providing the latest, most authentic information* on condenser and heat exchanger tubes, which has its source in the broad experience of our engineers and the findings of our laboratories. *Service in Men* offers specialized consultation on individual tube application problems and suggestions regarding alloy selection and tube installation practice. *Service in Metals* includes the production of a broad range of tube alloys under laboratory control, which verifies that Scovill alloys selected conform to requirements of specifications.

*For a free copy of the "Scovill Condenser Tubes" booklet, address Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Conn. *Export Department:* 405 Lexington Ave., New York 17, N.Y.

This is Number Eighteen in a series of Scovill advertisements to help you get longer life from condenser and heat exchanger tubes.

SCOVILL

SCOVILL CONDENSER TUBES

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Service in Manuals... Service in Metals... Service in Men

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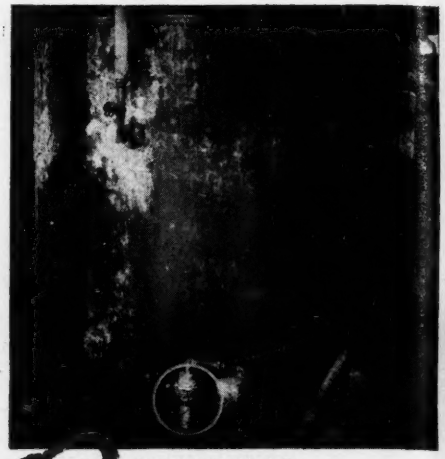
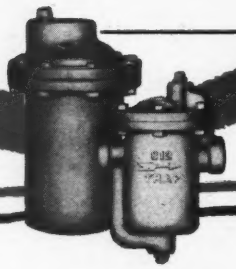


$2500 DAILY GAS SAVING
Heineman Chemical Co., Crosby, Pa.



* ARMSTRONG UNIT TRAPPING

WHAT? It is systematic planning of trapping to provide an individual trap of correct size and type for each separate steam condensing space.

WHY? Prevents short-circuiting, air locking, water pockets, sluggish drainage. Purges both air and condensate.

WHERE? Applicable to every place where steam is used for power, process, or heating work.

WHEN? The sooner the better.

HOW? Your local Armstrong representative . . . Armstrong Machine Works . . . or the Armstrong Steam Trap Book will give you complete information.

ARMSTRONG MACHINE WORKS pioneered UNIT TRAPPING* back in the days when it was customary to pipe a half dozen, or more, drain lines into one big pot type trap . . . when traps were considered "a necessary evil" . . . when the main idea was to use as few traps as possible. Armstrong made it practical and profitable to use UNIT TRAPPING* by developing:

1. A trap that does not require attention. (All Armstrong traps are non-airbinding and self-scrubbing).
2. Small traps with big capacity. (Unexcelled—thanks to Armstrong's patented leverage).
3. Moderately priced traps—economical to use on individual units; a size for every purpose.
4. Scientific data on how to use traps.

TODAY, ENGINEERS EVERYWHERE KNOW THAT AN INDIVIDUAL TRAP SHOULD BE USED ON EACH DRAIN LINE, YET THERE ARE STILL NUMEROUS PLACES WHERE OLD-FASHIONED TRAPPING IS COSTING PLANTS MONEY EVERY DAY!

It will pay such plants to give "trap modernization" top priority in postwar planning. Most of these jobs require only small expenditures and little labor, yet they pay big dividends. Ask for a copy of the Armstrong Handbook on Condensate Drainage—it gives you all information needed to plan your jobs.

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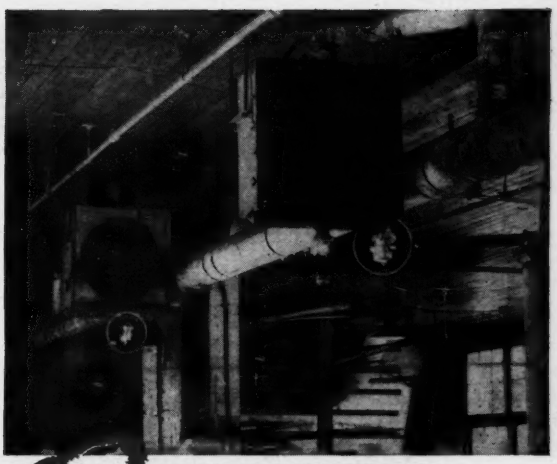

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...says

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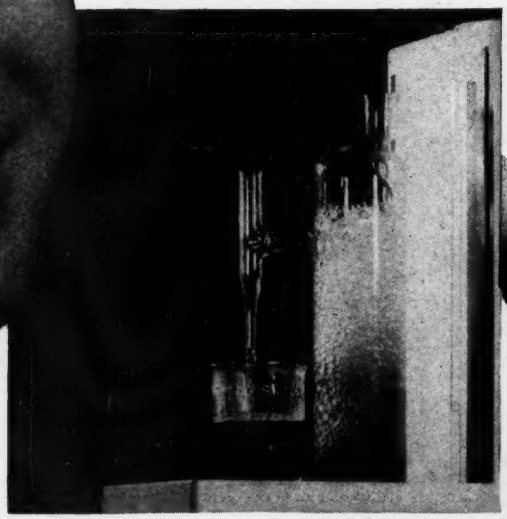

Photo in Nalco Laboratories

BOILER carryover resulting from foaming can cause damage ranging from corrosion and scaling in steam lines and equipment to outright wreckage of engines and turbines . . . And the place to lick it is *not* in your own boilers—but in the Nalco Laboratory devoted to anti-foam research and remedies for foaming.

Like any other phase of good water treatment, there is no single cure-all for foaming. Nalco Laboratory testing under your particular plant operating and water conditions guarantees treating chemicals and control recommendations that solve *your* problems. No obligation is involved in a complete Nalco Survey for your plant. . . . Ask for it today.

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THE SCIENTIFIC WATER TREATMENT FOR ALL INDUSTRY

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on postcard below, detach and mail.

BOILERS, AUXILIARIES

1 **Slag Removed** — Bulletin 454 tells about this company's product which was developed to remove hard slag and other combustion deposits from tubes and other metal boiler surfaces, and from furnace refractory walls, by chemical means. It is pointed out that this vapor is blown into the furnace walls while it is in regular operation. Its use minimizes the necessity for taking the boiler off the line to do the cleaning job manually. Gamlen Chemical Co.

2 **Insulating Lagging**—Bulletin 327G, 8 pgs. This bulletin describes the product, tells of its properties and advantages, lists the uses by industry, shows how it cuts heat losses, and presents two full-page tables, one for the heat loss through graduated thicknesses of Insulag and the other indicating the efficiency or per cent of heat saved by the application of various thicknesses of the material. Quigley Company, Inc.

3 **Boiler Feed Make-Up**—Bulletin 364, 26 pgs., tells about evaporators for distilling boiler feed make-up. Besides describing and illustrating the many different types for various capacities and pressures the bulletin contains several sections of special interest to plant engineers. These include an explanation of the functions of evaporators, the advantages obtained by their use, the different types of evaporator systems and their relationship to plant heat balance. The bulletin is profusely illustrated. The Griscom-Russell Co.

4 **Continuous Boiler Blowdown**—A catalog (No. 102) of boiler blowdown valves and assemblies is accompanied by an article which tells, simply and nontechnically, of the whys and wherefores of the desirability of continuous blowdown. The catalog shows cross-sectional drawings of the equipment, lists the outstanding features and presents a table of parts and prices. Strong, Carlisle & Hammond Co.

5 **Steam Generator**—Fourteen pages are included in this collection of bulletins on steam generators, feed water pump sets. One of the bulletins on the steam generator shows the wide range of fuels, proved efficiency, quick steaming and safety of the unit. Burner controls are described and table of ratings and dimensions is published. The feed water pump sets are for use with the steam generator; tabular material, equipment and specifications are outlined, construction details are given, and operation is described. Cyclotherm Corp.

6 **Refractory Data Book**—Anyone concerned with refractories and furnace construction problems will find helpful reference material in the new data book entitled "Refractory Specialties." The book contains numerous cross-sectional drawings, charts, technical illustrations, definitions of terms, formulas, temperature conversion tables, properties of gases and other data. Also presented is information about plastic refractory products and about refractory manufacture, design and construction. The Ramtite Co.

7 **Power Plant and Industrial Process Equipment**—Bulletin Q12, 20 pgs., tells about this company's equipment for the boiler room, diesel electric power, for the turbine room and for processing. Excellent illustrative material shows turbines, turbine generators, motors, feedwater heaters and deaerators, condensers and auxiliaries, steam jet ejectors, centrifugal blowers, turbochargers and accessories. Elliott Co.

8 **Soot Blowers**—Bulletin No. F45, 32 pgs. Consists of description of soot blowers in general, what causes soot. Gives description and operation of the company's soot blowers, materials and specifications, tables of steam consumption for blowers. Tables of fuel savings, boiler efficiency, steam flow, etc., make the booklet helpful. Cross-sectional drawings show location of blowers on different types of boilers. Marion Machine, Foundry & Supply Co.

ELECTRICAL

9 **Guide to Electronics**—Booklet A-4726. To show how elecontrnics is already speeding production, saving time and materials, promoting safety in industrial plants, and to suggest how other factories can put electronics to work, is the purpose of "The Businessman's Guide to Electronics," just published. The booklet explains the 6 fundamental functions of electronic tubes — rectifying, amplifying, generating, controlling, counting and sorting, and inspecting and tells which tube is needed for which function. There are 28 pages in the book. Westinghouse Electric Corp.

10 **Electrical Indicating**—Here is a new publication titled "Weston Engineering Notes," which will serve as a medium to provide pertinent application engineering information for users of electrical indicating instruments. The first issue (February, 1946) featured articles such as "The Galvanometer and the Bridge," "Copper Oxide Rectifiers As Used In Measuring Instruments." Anyone interested in instrumentation problems will be placed on the mailing list upon request. Weston Electrical Instrument Co.

11 **Light Conditioning**—Bulletin CDP-527 issued recently by this company describes the use of plastics for reflectors and shades. All models now available from distributors are listed and the characteristics of each type are told. The booklet is well illustrated and contains 12 pgs. General Electric Co., Pittsfield.

12 **Hints on Wiring Maintenance** — A practical working program to keep your electrical system in condition is outlined in a preventive Maintenance book issued by Anaconda Wire & Cable Co. Also contains wiring diagram symbols, hints in motor selection, routine tests, etc.

13 **Cartridge and Plug Fuses**—Bulletin 54-512 contains 28 pgs. of information on fuses, How a Fuse Operates; Time-Current Characteristics; Non-Renewable Fuses; Renewable Fuses; Plug Fuses; Entrance switches; Fuse Pullers and others. It shows what to demand of a fuse and lists tabular specifications of the fuses described. Maintenance and care of fuses and fuse "preparedness" is an important section of the booklet. General Electric Co., Bridgeport.

14 **Selenium Rectifiers**—Portable, high-rate selenium rectifiers are covered in this new bulletin. Photographic illustrations, circuit diagrams and engineering drawings, tables and technical descriptions make this bulletin particularly valuable. Bulletin RDP 104, 4 pgs. Fansteel Metallurgical Corp.

15 **Formulas for Electrical Engineers**—An 8 pg. folder "Conversion Factors" and Formulas for Electrical Engineers" has just been published by the I-T-E Circuit Breaker Co. Contains over 600 conversion factors commonly used by electrical engineers as well as definitions of basic electrical units, prefixes, mensuration and temperature conversion factors. The lists are arranged for use in a loose-leaf binder or for desk or wall mounting. Factor tables have been lacquered to add durability.

VALVES, PIPING

16 **Guide for Pipe Users**—A new 56-pg. catalog, featuring application of lightweight pipe in diameters from 4 to 30 in., has just been issued by the Naylor Pipe Co. Installation photos show application of Naylor Lockseam Spiralweld pipe in fields in which light-weight pipe is used to advantage. Along with valuable data on pipe structure are sections on precision fabrication and pipe connections including an entirely new type of coupling which saves time and labor for users.

17 **Solenoid Valve**—Bulletin 462 is a 4-pg. item which describes the Type V5-100 three-way two-position valve and gives specifications and ordering information on the unit. Allied Control Valve Co.

18 **Insulated Pipe Conduit Systems**—Primarily intended as an exposition of the use of this system in airports and titled "Looking Ahead—To The Airport Center of Tomorrow," this booklet presents information which can readily be adapted to other central types of heating systems. It is profusely illustrated and a description of the boiler plant is broken down into costs and calculations have been made regarding the amount of steam each building will require. The Ric-Wil Co.

WATER CONDITIONING

19 **Water Treatment Consultation**—Included in this booklet are seven architectural flow diagrams so chosen as to present a representative cross-section of the various types of problems and to show how these problems were solved in each particular case. These flow diagrams embrace plants for softening water for industrial use, for waste treatment, for sewage disposal and for pre-treatment of water for boiler feed. 24 pages. W. H. and L. D. Betz.

20 **Industrial Filters**—Water filters for grease and oil extraction are covered in this 8-pg. bulletin. Two types of filters are considered in the booklet; piping layouts, dimension tables and dimensioned drawings add usefulness to the bulletin. Applications and advantages are listed and specifications are presented. The Blackburn-Smith Mfg. Co., Inc.

INSTRUMENTS, CONTROLS

21 **Pressure Regulators**—Bulletin J-2, 4 pages. Tells about furnace pressure regulators, boiler steam pressure controls, pressure reducing valve operation. Complete engineering drawings are shown and the features and advantages of the units are listed. Brooke Engineering Co., Inc.

22 **Surface Pyrometers**—Bulletin 194-SA, 12 pgs., tells about the applications of these surface pyrometers for such uses as checking external temperature of insulated piping, checking temperatures of motors, etc. These applications and many others are described, the instruments are shown and their construction explained. The bulletin is well illustrated. Cambridge Instrument Co.

23 **Pitot Equipment Data Handbook**—This 20-pg. Bulletin 50 is divided into three main sections: No. 1—Instructions for the use of the pitot tube and mano-

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meter; 2—Instructions in use and care of portable pitot recorder; 3—Theory, formulas, notations, tables and curves for use with pitot tubes, manometers and recorders. Simplex Valve and Meter Co.

24 **Flow Indicators**—Bulletin 18W tells about three types of flow indicators made by this company—the rotary type, the flapper type and the distillate type. Photos of each are shown, descriptions are given. Tabular material assists in selecting the proper size indicator. Flow indicator applications is a helpful feature of the bulletin. Schutte & Koerting Co.

25 **Speed Indicator**—This bulletin tells about the company's hand tachometer which has 5 speed ranges. A complete description of the four models in which the tachometer is made is presented and the construction and use features of the unit are described. Specifications are also given. George Scherr Co., Inc.

26 **Controlling Feed Flow**—Bulletin 449, 4 pgs., tells about the method of controlling the feed flow and water level on a chemical plant's Foster-Wheeler type S-A steam generator. Flow meter charts show operation for a typical day for feed flow, steam flow and water level. The significant data are presented. Northern Equipment Co.

27 **Bristol Publishes New Catalog**—A new general catalog entitled "Specification Index for Bristol Instruments," has been published by the Bristol Co. Contains 24 pgs. of information on the Bristol line of automatic controlling, recording and indicating instruments and gives hints on how they can be used effectively to save time, and money and promote efficient operation. Specification data is given on each instrument listed.

28 **Catalog Shows Foxboro Instruments**—The Foxboro Co. has just issued Catalog 370, presenting the company's full line of recording and indicating instruments for measurement and control. Arranged for quick reference, and profusely illustrated, the sections deal with instruments for temperature applications, pressure, humidity, flow, liquid level, density and other process variables. Control valves, planimeters, instrument accessories and supplies are included. Also describes Foxboro's line of Dynalog electronic instruments.

29 **Hot Water Controller**—This controller, designed to guard against the dangers of scalding water in shower baths and wash sinks, is completely described in this 4-pg. bulletin. The design and construction of the unit is considered; list prices, capacities and shipping weights are presented in tabular form and a chart for determining the size of controller to be used in various installations. Photos of typical jobs are included. The Powers Regulator Co.

30 **Flow Rate Measurement**—Bulletin 22 tells about this company's line of fixed and portable manometers for use in water surveys and similar flow rate measurement. Descriptions, tabular material and photos are made highly useful by a section labeled "Manometer Data," which presents flow formulas and other engineering information. Simplex Valve & Meter Co.

TOOLS

31 **Tools**—Catalog 46-J contains 20 pgs. and shows many of the tools in the company's line. Typical are wrench sockets, bench sets, wrenches, special attachments, open-end miniature wrenches, electrical wrenches, tappet wrenches, gauges, hack saw blades and frames, screw drivers, hammers and special tools. Charts of sizes and a numerical index is a helpful feature. Bonney Forge & Tool Works.

32 **Handbook of Hack Saw Care**—Selection of proper blades for cutting various metals, causes and cures of common blade difficulties, and hints on "how and how not to do it" are featured in a new 30-pg. illustrated booklet offered by Clemson Bros., Inc. Entitled "Metal Cutting," this pocket-size booklet includes data on both hand and power blades, and except where text states otherwise, the recommendations apply to blades of all manufacturers.

WELDING

33 **Electrode Holders**—This booklet tells about a complete new line of manual arc welding electrode holders. Clear illustrations of each piece of equipment are given and specifications—amperage capacity, electrode capacity, weight, length, handle diameter and price—are published. Other items described are machine terminals, cable connectors, mechanical cable lugs, cable splicers, etc. Tweco Products Co.

34 **Guide to Everyday Welding**—New 8-pg. booklet titled "Guide to Everyday Welding" is offered as a guide in the selection of the proper type of electrode or gas welding wire to use for welding various types of materials, structure and equipment. Information is arranged in easy-to-find tabular form, indexed by industries, listing types of jobs and equipment on which welding is used, showing character of welds and types of electrodes or gas welding rods for each application. Condensed chart shows physical properties, current recommendations and analysis of weld metal deposit for stainless steel, carbon steel, shielded arc and bare and subcoated electrodes and gas welding wires. Page Steel & Wire Division, American Chain & Cable Company, Inc.

MAINTENANCE

35 **Maintenance Guide**—This new, profusely illustrated maintenance guide will serve as a handy reference for guidance in solving the maintenance problems arising in the operation of power plants, water works, sewage disposal plants, incinerators, water filtration plants, etc. Dealing also with "basement to roof" building maintenance the guide will be of value to every man interested in a practical solution to these maintenance problems. Stonhard Co.

36 **Air and Gas Aftercoolers**—The removal of moisture and oil by condensation before these substances enter the distribution lines is explained by this bulletin as preventing ten types of costly troubles. The equipment is pictured and its operation explained. Tables of specifications and dimensions are given and a cut-away picture of the unit is published. Sullivan Machinery Co.

37 **Machinery Cleaning**—Of interest to power plant engineers, superintendents and others responsible for maintenance cleaning of plant, machinery and equipment is the booklet just issued. Described in it are many applications for steam detergent cleaning of: 1. machinery equipment and parts for subsequent repair and overhaul; 2. equipment surfaces before painting or refinishing; 3. equipment too large for tank immersion; 4. paint stripping. Savings are reported to be nearly 50 per cent of former costs. Oakite Products, Inc.

PUMPS, COMPRESSORS

38 **Turbine Pumps**—Bulletin ABQ400.1 contains a 24-in. cross-sectional photo of this company's oil lubricated turbine pump and the features of the unit are pointed out on this illustration. Directions for selecting the turbine pump are given and a table of sizes and ratings helps in specifying the proper unit. 6 pages. Fairbanks, Morse & Co.

39 **Refrigeration Compressors**—Bulletin C-1100-B23, six pages. Tells about the construction features of this compressor, the lubrication method, capacity control, etc. The back page of the bulletin presents two dimensioned line drawings with two tables of dimensional information. Worthington Pump & Machinery Corp.

MISCELLANEOUS

40 **V-Belt Sheaves**—This is a 4-pg. bulletin which describes, by pictures, the method of mounting the sheave on the shaft and also how to remove. A check list of applications where these sheaves are a "must" and features of the sheaves are given. Allis-Chalmers.

41 **Metal Applications**—"400 Practical Applications for Monel, Nickel and Inconel Under Corrosive Conditions" is the title of this 28-pg. booklet. The entire booklet is arranged in tabular form under these headings: Corrosives; Industry or Process in Which Monel, Inconel or Nickel is Used; Monel is Used For; Nickel and Inconel Are Used For. The back section of the book discusses the properties of the metals including machining, mechanical properties and welding and brazing. International Nickel Co.

42 **Draftless Air Diffusers**—Bulletin 20, 12 pgs. Principle of operation, types of diffusers, method of assembly for the installation of ceiling units, types of dampers, outlets, facilities for subcontracting, research and typical installations are all features of the book. Anemostat Corporation of America.

43 **Rivet-Nut Data Book**—This exceedingly useful little book (38 pgs.) tells about this newly developed combination rivet and nut called the "Rivnut." It is a one-piece tubular rivet that can be headed from one side. It is pointed out that they are the only one-piece blind fastener that can be used as blind rivets, as nut plates for attachment or both at once. The booklet shows the various types, tells how to select the proper type, drilling and preparing the hole, how to install, how to remove, how to order tools and parts, examples of uses, test data, charts and accessories. The B. F. Goodrich Co.

44 **Water Heaters**—Fifteen full-page booklet-bound tables of water heater capacity ratings for heaters using low pressure or live steam at gauge pressure of from 1 to 150 lbs. The tables cover temperature rises of from 20 to 150 F based on water inlet temperatures of 50 F. The tables show total requirements in Btu and lb. of steam per hour. From these tables it is possible to readily determine the exact requirements for heating any smaller, intermediate or larger amounts of water. Tables also show flow of steam through pipes at from 1 to 50 psi pressure. Marion Machine, Foundry & Supply Co.

45 **Clamshell Buckets**—Catalog 2059. 42 pgs., tells about the four-rope clamshell buckets designed for handling coal and other materials of a similar nature. Types of buckets, methods of reeving, cable data, price and specification ordering information, special features, typical uses and users are given. Blaw-Knox Co.

46 **Fire Fighting**—This booklet, "Air Foam," tells the story of a modern weapon developed to kill flammable liquid fires. Photographs show results of applying the Air Foam under different atmospheric conditions and the story tells why the results are what they are.. Photos of actual fires extinguished by this method are shown. Pyrene Manufacturing Co.

(Continued on page 169)

JUNE

POWER PLANT ENGINEERING

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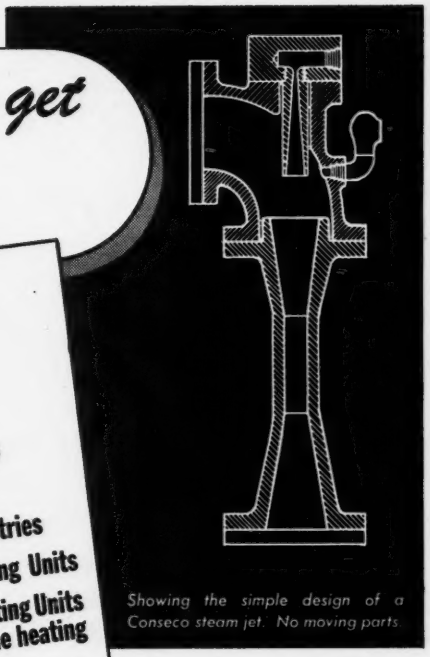

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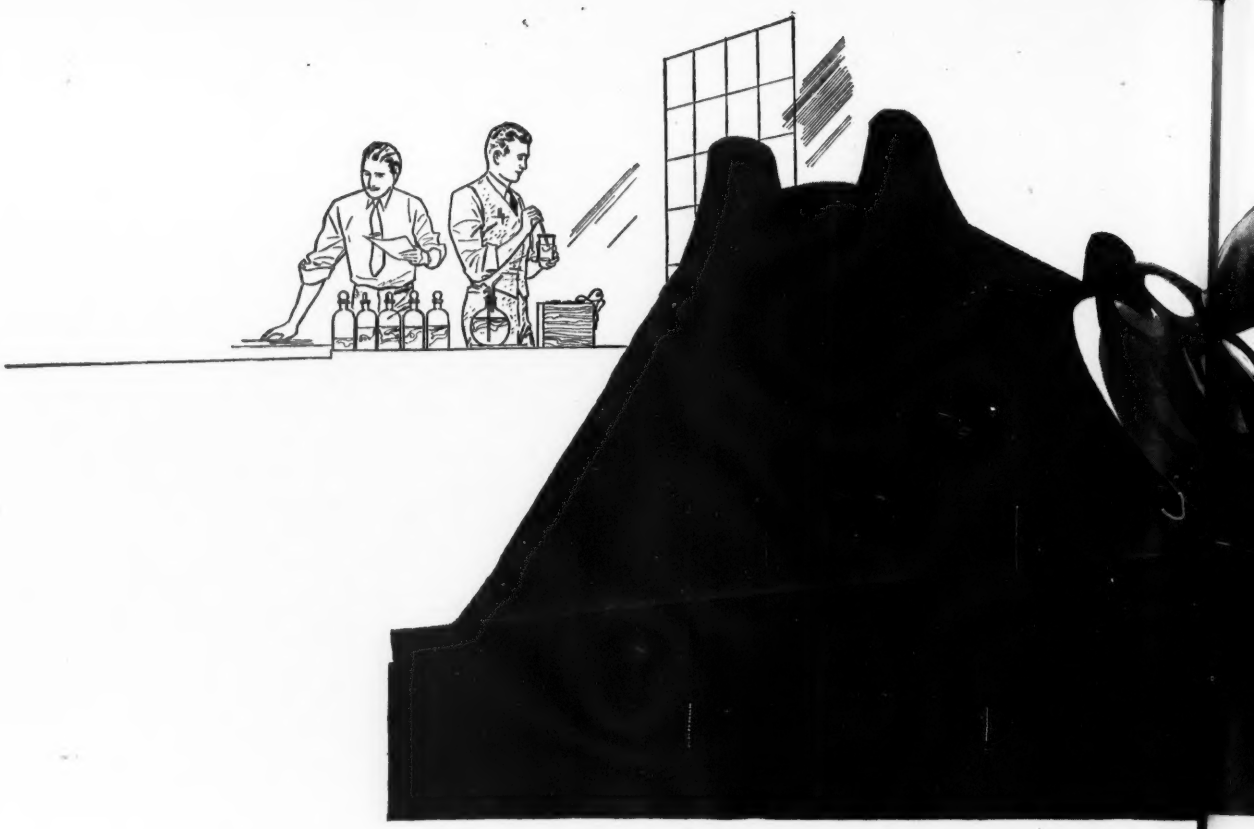

the Hall engineer showed

The 450 psi, 80,000 pounds per hour cross-drum boilers at a southern power plant had to be pushed hard to meet wartime demands. As a result, when one was taken out for inspection a hard black scale half an inch thick was found to have been formed in the tubes of the lower rows of the upper generating bank, in spite of the fact that satisfactory boiler water conditions had been maintained.

The insurance inspector recommended turbining. This turned out to be a long and tedious task. As much as four hours was required to get the turbine through a single tube.

A sample of the scale was rushed to Hall Laboratories. Analysis showed the presence of large amounts of sodium phosphate, sodium silicate and sodium sulphate, leading to the belief that the deposit would be largely water-soluble.

The Hall service engineer for that territory, who happened to be in Pittsburgh, went to work on the problem. Boiling the material in water gave negative results, probably because the high temperature to which it had been heated in the tube had glazed the sodium silicate.

Dilute hydrochloric acid also gave negative results, which

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.

(A subsidiary of Hagan Corporation)

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CALGON

how to cut turbining time 90%

should probably be attributed to the formation of a film of silica over the deposit as some of the sodium silicate was attacked by the acid.

Boiling the scale in a two percent caustic soda solution gave the results desired. Much of the material was dissolved and the rest was so softened that it could be broken up easily. This information was at once telephoned to the plant engineer. He arranged to purchase caustic soda and sodium nitrate, the latter recommended as a safeguard against embrittlement. The Hall service engineer went to the plant to supervise the boiling out of the boiler.

When the boiler was drained and flushed out it was found that the deposit had softened to such an extent that the turbine could be put through a tube in 15 to 20 minutes, instead of 3 to 4 hours.

That incident is typical of Hall Service. When trouble occurs, Hall engineers have just one assignment—to end that trouble and get the boiler back on the line at the earliest possible moment.

Every plant that generates its own steam can profitably use Hall Service. Write for full information.

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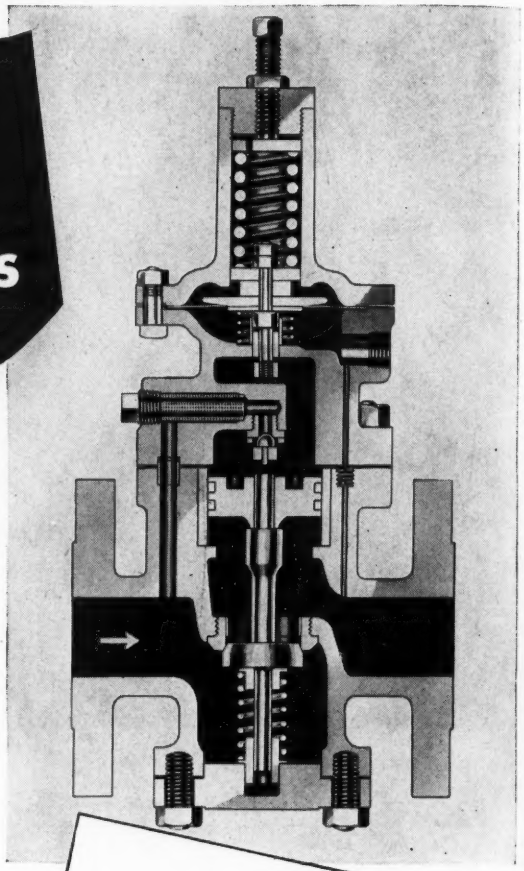

For Sensitive Pressure Regulation, Use This Single-Seated, Pilot-Controlled Valve!

Recommended especially for:

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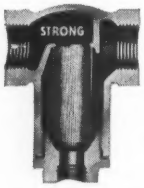
- **Processes requiring extremely sensitive control;**
- **Applications where dependability is essential.**

STRONG Type C Valve, illustrated at right, available in semisteel or cast steel, for pressures to 400 psi (600° F.). With ANUM-METL* seats and discs, optional internal or external pilot control, this valve automatically adjusts itself to maintain accurate reduced pressure.

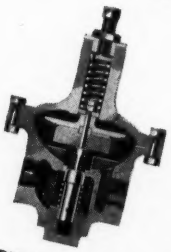
Completeness of the STRONG line—steam traps, vacuum traps, pressure regulating valves, strainers, separators, continuous blowdown valves and other steam specialties—enables us to recommend exactly the right type and size for your particular application. Write us about your problem and ask for the new STRONG Regulating Valve Catalog No. 155.



STRONG "Quick-Cleaning" Strainers

STRONG improved strainers, of semisteel or cast steel construction, protect reducing valves, steam traps, control equipment, etc., by taking out scale, dirt and sediment. Available in "T" or "Y" types.

STRONG, CARLISLE & HAMMOND COMPANY
Cleveland 13, Ohio



TYPE K REDUCING VALVES are direct operated, single seated and of extra heavy semisteel construction suitable for pressures to 225 psi (400° F.). Features ANUM-METL seat and disc and internal strainer. For steam, air, water or gas.

*Trade Mark Registered.

REG. TRADE MARK

OTHER **STRONG** STEAM SPECIALTIES

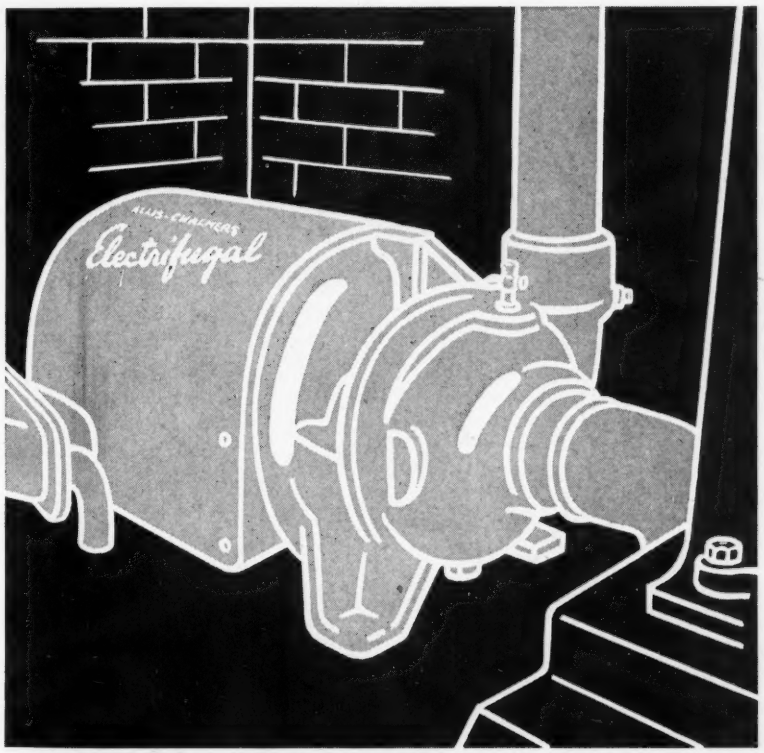
ANUM-METL Reg. Trade Mark

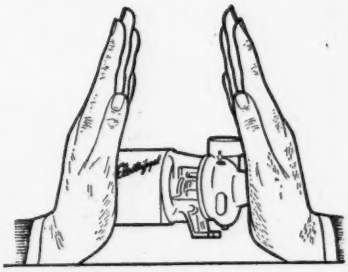
Blast Trap | No. 80 Series Trap | Large Capacity Trap

Economical "Package" Pump Saves SPACE and MONEY

By combining pump and motor into one compact unit, Allis-Chalmers engineers created the "Electrifugal" pump — that requires *one-third less space.* But . . . more than that . . . it costs you *less to buy — less to install — less to operate* — and has a wide range of applications.

The "Electrifugal" pump is a popular member of the complete Allis-Chalmers line of centrifugal pumps and motors: single or double suction — multi-stage — capacities to 170,000 gpm.





MORE QUICKLY INSTALLED

Comes completely assembled. Just bolt down four supports, make pipe and power connections — and start pumping! Operates in any position.

MORE QUICKLY SERVICED

Easy to get at rotor, impeller, packing and all moving parts. Take it apart and put it together fast. Down time reduced to a minimum.

YOU SAVE ON MAINTENANCE

Ample bronze wearing rings — seal cage and valve—shaft sleeve and deflector — five packing rings — precision workmanship and other quality features add up to longer life, less maintenance cost.

UNDIVIDED RESPONSIBILITY

Allis-Chalmers builds both pumps and motors — backs them up with unsurpassed experience and reputation in both fields. Call your A-C office or dealer for help on any pumping problem . . . or write for bulletin No. B6018. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

TIGHT SQUEEZE! — But this "Electrifugal" pump was built for close quarters. Allis-Chalmers engineers have developed and perfected the close-coupled pump through 20 years of experience. Built in stock sizes from ¾ to 25 h.p.

A 2037

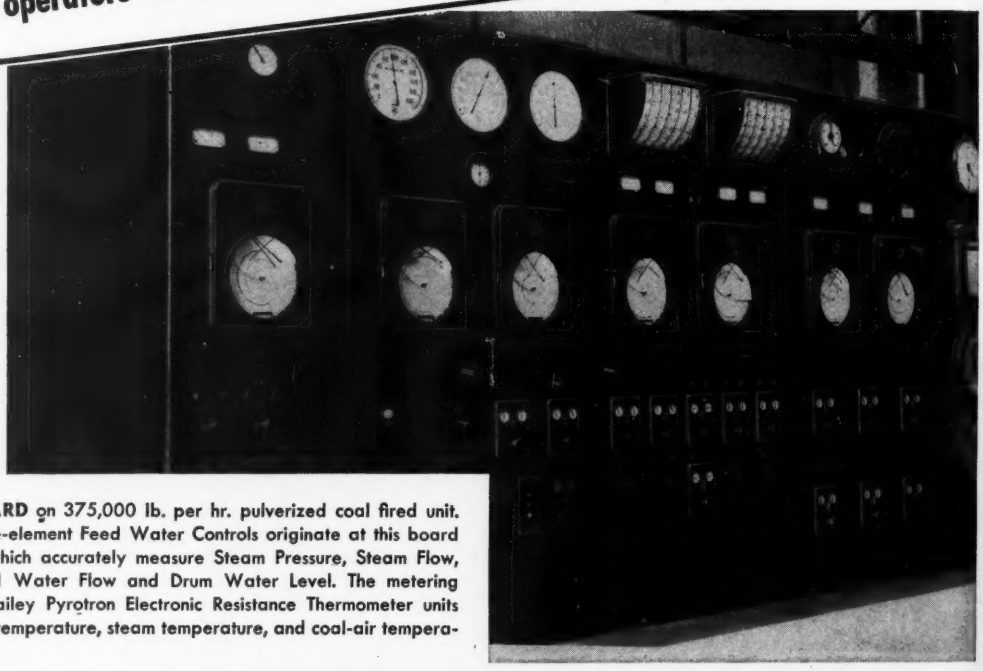
ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment-
Biggest of All in Range of Industrial Products

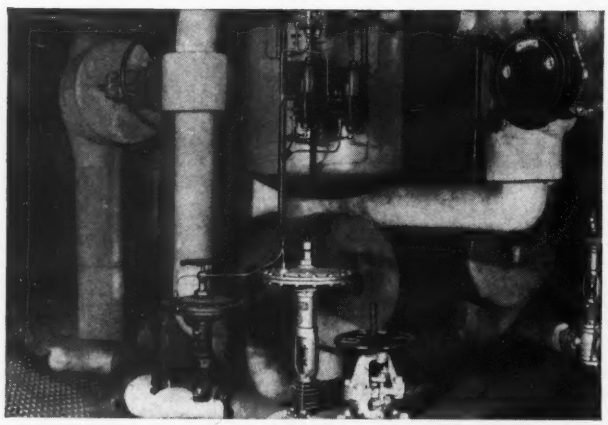
Electrifugal PUMPS

Dedicated to Optimum Steam Plant Performance

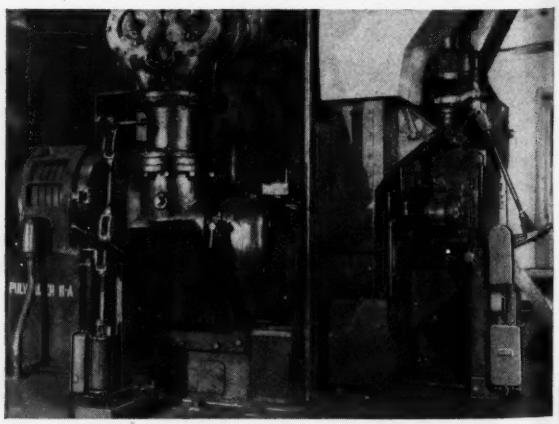
Bailey Controls at Williamsburg Station of Pennsylvania Edison Co. help operators to secure Safety, Economy and Continuity of Service



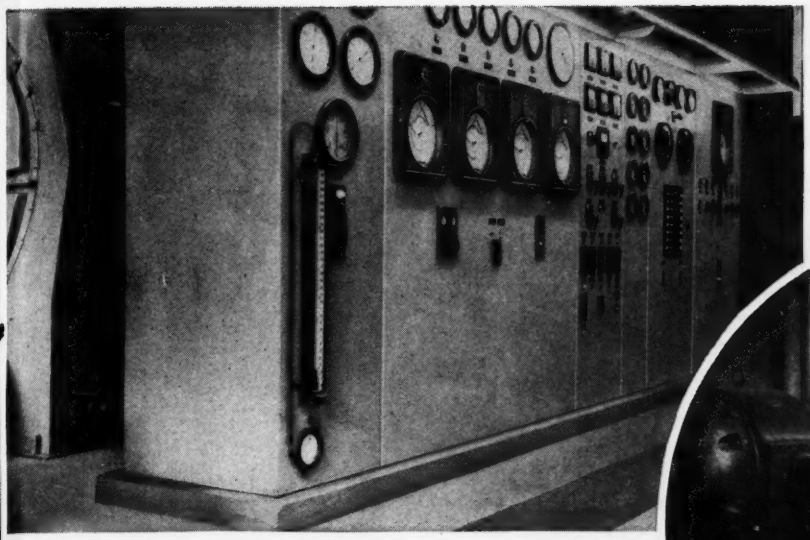
BAILEY BOILER BOARD on 375,000 lb. per hr. pulverized coal fired unit. Combustion and Three-element Feed Water Controls originate at this board from Bailey Meters which accurately measure Steam Pressure, Steam Flow, Air Flow, Draft, Feed Water Flow and Drum Water Level. The metering equipment includes Bailey Pyrotron Electronic Resistance Thermometer units to record feed water temperature, steam temperature, and coal-air temperature at each mill.



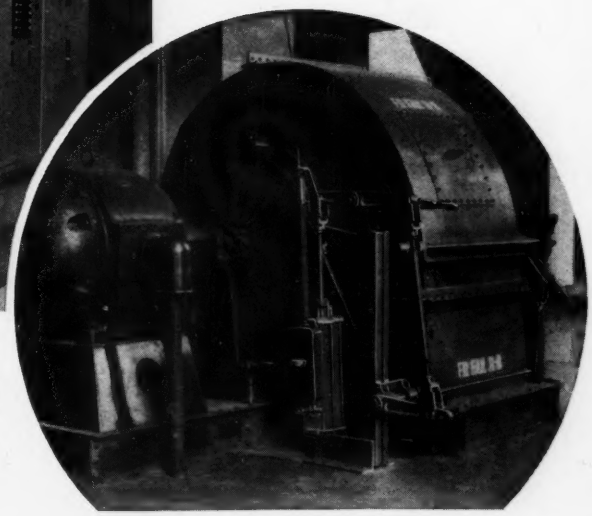
HEATER DRAIN CONTROL. Bailey Level Controller and relays regulate drain valves to maintain the desired high pressure drainer level.



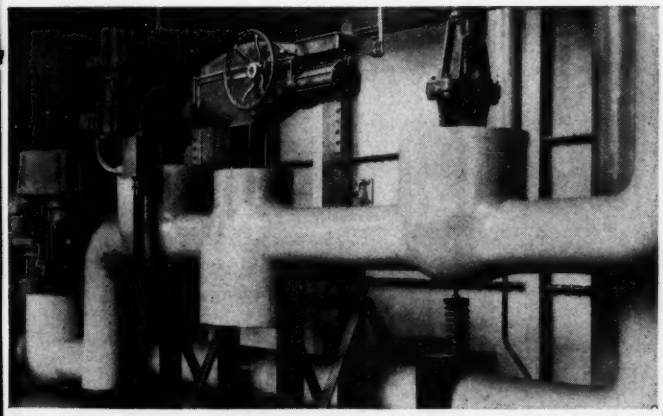
PULVERIZER CONTROL. These Bailey Control Drives regulate raw coal feed and coal-air output from a Riley Atrita Pulverizer in accordance with boiler load demand as measured by the Bailey Master Steam Pressure Controller.



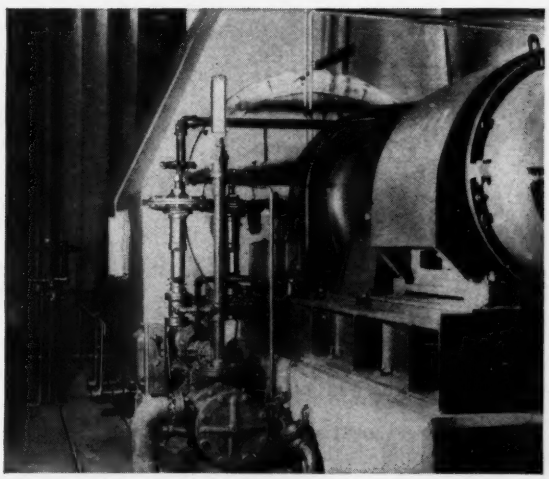
TURBINE BOARD. A Bailey Three-element System of condensate control originates at this board from the first three recording meters which measure: (1) Total flow output from high pressure boiler feed pumps, (2) Condensate flow to No. 1 Heater, (3) Level in No. 3 Heater. The fourth meter records and integrates steam flow to the high pressure turbine and a fifth meter records pressure and temperature of desuperheated steam.



FORCED DRAFT FAN CONTROL. Bailey Control Drives position inlet vanes to supply air for combustion in accordance with the requirements established by the Master Steam Pressure Controller and the Bailey Boiler Meter.



BAILEY THREE-ELEMENT FEED WATER CONTROL VALVE. This powerful valve regulates feed water input to the boiler so that it equals steam output and maintains a safe drum level at all times. Control impulses originate from the accurate measurements of Bailey Meters on the Boiler Board.



INDUCED DRAFT FAN CONTROL. Bailey Control Drive and Valves regulate the induced draft damper and the hydraulic coupling fan speed control to maintain the desired furnace draft.

All photos by the courtesy of Burns & Roe, Inc. For more information on coordinated Boiler Control Systems, such as installed at the Williamsburg Station, ask for Bulletin 15-C.

A-96

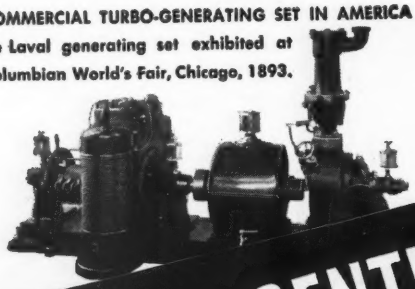
BAILEY METER COMPANY

1040 IVANHOE ROAD • • • CLEVELAND 10, OHIO

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Controls for Steam Plants

FIRST COMMERCIAL TURBO-GENERATING SET IN AMERICA
De Laval generating set exhibited at Columbian World's Fair, Chicago, 1893.



A HALF CENTURY OF PROGRESS in TURBINE DESIGN by DE LAVAL

MODERN DE LAVAL MULTI-STAGE TURBINE
driving a 6,000 kw, 60 cycle alternator.

The highly perfected De Laval turbines of today are the direct result of the early achievements of Dr. De Laval, who in the year 1888 made the impulse type of turbine a practical and efficient power-producing machine by his invention of the diverging nozzle now employed in all impulse type turbines . . . For steam turbines of all types and sizes, consult De Laval.

T-1

TURBINES · HELICAL GEARS · WORM GEAR SPEED REDUCERS · CENTRIFUGAL PUMPS · CENTRIFUGAL BLOWERS AND COMPRESSORS · IMO OIL PUMPS

DE LAVAL STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA · BOSTON · CHARLOTTE · CHICAGO · CLEVELAND · DENVER · DETROIT · DULUTH · EDMONTON · GREAT FALLS · HAVANA · HELENA · HOUSTON · KANSAS CITY · LOS ANGELES · MONTREAL · NEW ORLEANS · NEW YORK · PHILADELPHIA · PITTSBURGH · ROCHESTER · ST PAUL · SALT LAKE CITY · SAN FRANCISCO · SEATTLE · TORONTO · TULSA · VANCOUVER · WASHINGTON D.C. · WINNIPEG

what's YOUR fastening problem

HOW CAN I PREVENT NUTS FROM FREEZING TO STEEL STUDS ON HOT EXHAUST LINES OF DIESELS?

—asks a chief engineer

WHAT'S THE RIGHT METAL FOR BOLTS THAT WILL STAND 700° F. WITHOUT LOSING STRENGTH?

—asks a furnace manufacturer

CAN WE GET BOLTS THAT WON'T POP OFF THEIR HEADS DUE TO SEASON-CRACKING?

—asks a manufacturer of outdoor switching equipment

HOW CAN WE GET FASTENINGS THAT RESIST ACID AND CAUSTIC?

—asks a manufacturer of chemical equipment

TO MATCH OUR TRIM, WE NEED SILVERY-WHITE SCREWS. WHAT METAL WON'T RUST, TARNISH OR LOSE ITS FINISH?

—asks a display cabinet manufacturer

ARE THERE BOLTS THAT WILL GIVE ME THE STRENGTH OF STEEL PLUS SALT-WATER RESISTANCE?

—asks a boat builder

IF YOU NEED . . . bolts . . . nuts . . . screws . . . nails . . . rivets . . . cotter pins . . . washers . . .

TO RESIST . . . corrosion . . . rust . . . heat . . . impact . . .

YOUR BEST BET probably is use of Monel fastenings.

Specify Monel fastenings —for security

Reg. U.S. Pat. Off.

MONEL is stronger than structural steel . . . never rusts . . . resists corrosion by all natural elements and most chemicals (*including acids*) . . . stands impact . . . is ductile enough to absorb considerable overstressing. Monel fastenings are available in *all* standard types and sizes, or can be made to order for special jobs. ***Answer your next fastening problem with Monel*** and get longer service . . . less maintenance . . . smoother operation.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall St., New York 5, N. Y.

GENTLEMEN: Please send me a copy of *Engineering Properties of Monel Bolts*, plus the address of my nearest source of supply.

Name.....

Position.....

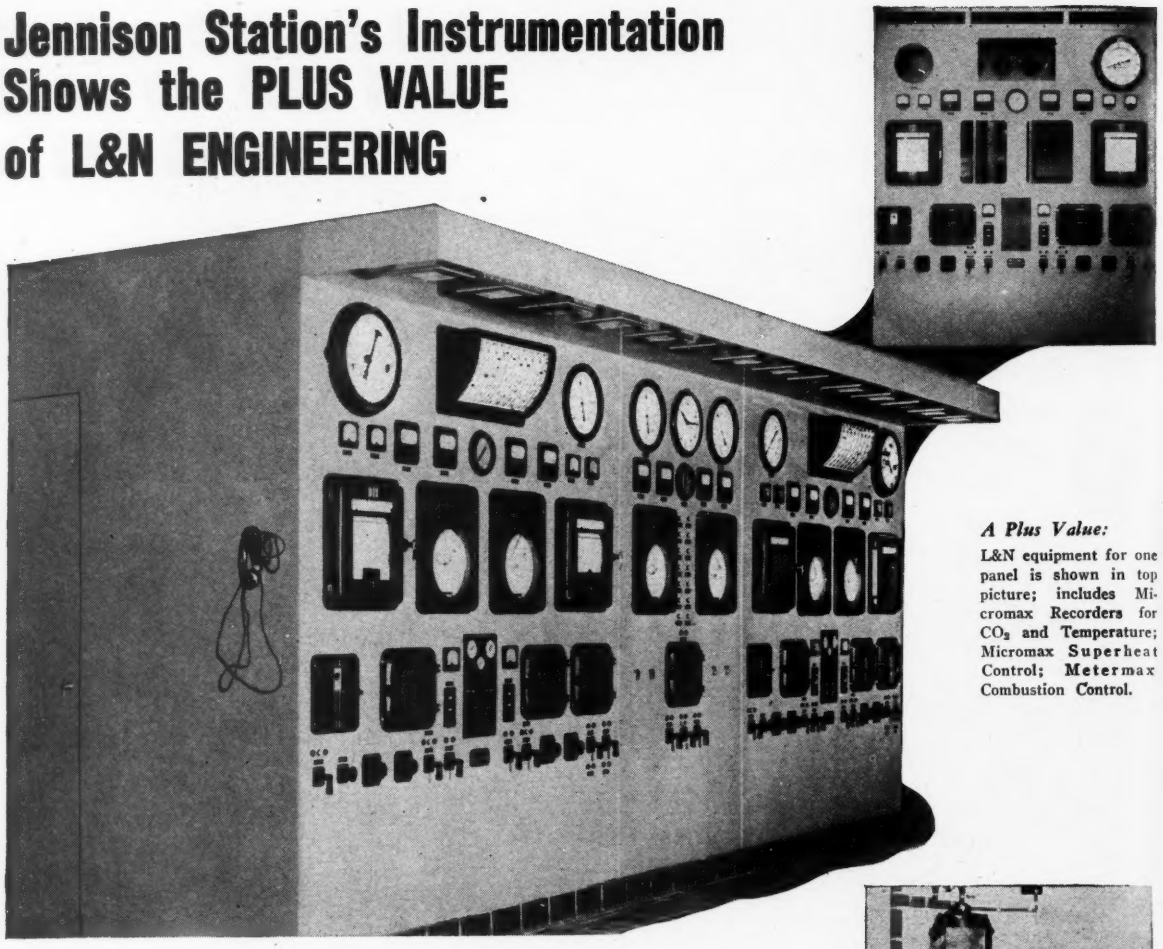
Company.....

Address.....

.....

P.P.E.6-46

Jennison Station's Instrumentation Shows the PLUS VALUE of L&N ENGINEERING



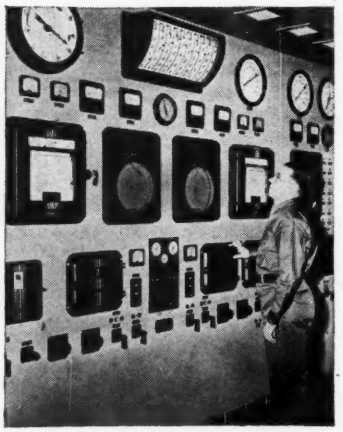
A Plus Value:
L&N equipment for one panel is shown in top picture; includes Micromax Recorders for CO_2 and Temperature; Micromax Superheat Control; Metermax Combustion Control.

Jennison Station of New York State Electric & Gas Corp. burns anthracite coal, on traveling grate stokers, beneath a pair of 200,000 lb/hr C. E. boilers.

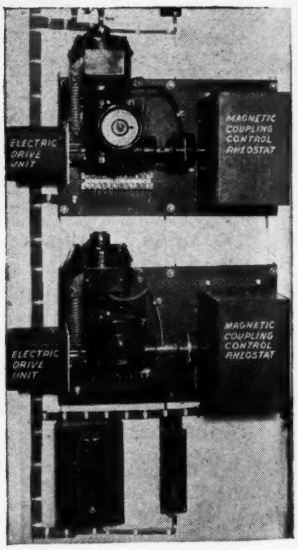
When the time came to discuss boiler and turbine Control Boards for this Station, the Corporation decided, on the basis of performance, to simply duplicate the installation in another of their plants. Accordingly, Metermax Combustion Control, Micromax Superheat Control and Micromax CO_2 Recorders were specified. Then the entire job of engineering the boards, to accommodate L&N and all other instruments, gauges, meters, etc., was turned over to us.

As a result, the Station saved engineering time, and installed boiler boards which experience already shows to be ideal "tools" for efficient boiler operation.

The same service which met the needs of this large Station is available for any power plant, either big or small. Just ask an L&N engineer to see you.



A Plus Value:
Instruments are arranged in sequence for efficient use; typical example shows operator can move a damper by Metermax Controller's built-in push button and at same time can read the draft gauge, Micromax CO_2 and Temperature Recorders.



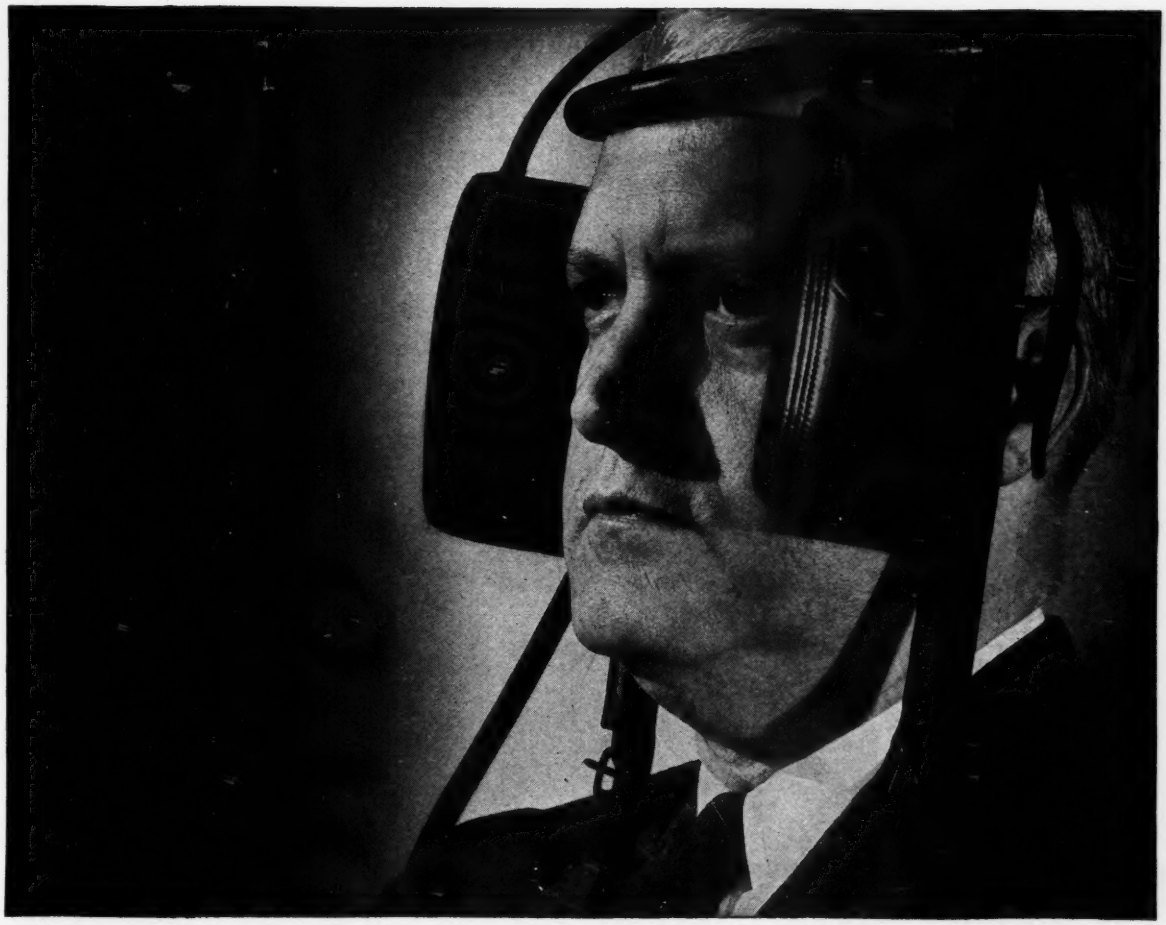
A Plus Value:
Induced-draft Fans, and Stokers, are Metermax-Controlled from Electric Drive Units inside Cubicle through electronically-controlled magnetic couplings.

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-163(13)



Meet the Man Who Makes a Virtue of a

ONE-TRACK MIND

Ordinarily, it is no compliment to say a man has a "one-track" mind. But in the special sense in which we apply the term to S-A engineers, it describes a singleness of purpose that saves American industry countless thousands of dollars on bulk material handling operations.

It describes an ability to approach any problem with but one thought in mind: the development of a system that will convey the *right* volume to the *right* place, at the *lowest* cost per ton. S-A engineers are aided in this task by an unrestricted choice of equipment—a complete line of conveyors and accessories designed and built by the company that for 45 years has led the field with new units and new methods.

If you want the man whose "one-track mind" can help you achieve utmost material handling efficiency, talk to an S-A engineer.

STEPHEN S-A ADAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF • BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

ASBESTOS IN ACTION

Structural materials that always stay young...

K&M *"Century"* FLAT ASBESTOS-CEMENT SHEET MATERIALS

Design and construction by the Austin Company

• For rugged strength and staying-power, K&M "Century" Flat Asbestos-Cement Sheet materials are unbeatable. K&M Standard Asbestos Lumber and K&M Monobestos are two such products that grow *tougher* with age, never need maintenance, and practically last forever.

The most recent addition to the "Century" Flat Asbestos Sheet family is K&M "Century" APAC—a sturdy, light-weight material that's highly resistant to the common enemies of most building materials. Fire, rodents, termites, weather, rot . . . APAC withstands them all, and seems to stay eternally young. Its 4′ x 8′ sheets are ideal for many types of industrial construction, such as walls, partitions, ceilings, elevator shaft linings—in fact APAC has as many uses as a building has surfaces.

K&M "Century" Flat Asbestos Sheet Materials hold the right answer to many construction problems. Write to us for full information on what they can do for YOU.

K&M best in asbestos

Nature Made Asbestos..
Keasbey & Mattison has been making it serve mankind since 1873

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

REPUBLIC CONTROLS
Are Being Specified

FOR ALL SIZES OF BOILERS AND ALL TYPES OF FUEL FIRING

TYPICAL INSTALLATIONS

SPREADER STOKERS

ALLIS-CHALMERS MFG. CO.
Springfield, Ill.
2 boilers: 68,000 lb./hr. each: 160 lb.

ALLIED CHEMICAL & DYE CO.
Chicago, Illinois
1 boiler: 45,000 lb./hr.: 125 lb.

BUICK AVIATION PLANT
Melrose Park, Illinois
1 boiler: 90,000 lb./hr.: 175 lb.

CHICAGO & NORTHWESTERN R. R. CO.
Green Bay, Wisconsin
2 boilers: 25,000 lb./hr. each: 125 lb.

HUBINGER CO.
Keokuk, Iowa
1 boiler: 150,000 lb./hr.: 500 hp.

CLINTON ENGINEERING WORKS
Clinton, Tenn.
3 boilers: 50,000 lb./hr.: 175 lb.

NORTHWESTERN YEAST CO.
Chicago, Illinois
1 boiler: 338 hp.: 140 lb.
2 boilers: 253 hp.: 140 lb.

MARSHALL CANNING CO.
Marshalltown, Iowa
1 boiler: 40,000 lb./hr.: 160 lb.

KRAFT FOODS
Albany, Minn.
2 boilers: 338 hp. each: 160 lb.

CHAIN GRATE STOKERS

ADAMS & WESTLAKE CO.
Elcart, Indiana
2 boilers: 500 hp. each: 125 lb.

BETHLEHEM STEEL CO.
Bethlehem, Pa.
4 boilers: 600 hp. each: 160 lb.

THE BERYLLIUM CORP. OF PA.
Temple, Pa.
2 boilers: 22,500 lb./hr. each: 145 lb.

CHICAGO, NORTHWESTERN R. R.
Chicago, Illinois
3 boilers: 45,000 lb./hr. each: 160 lb.

CLINTON PRODUCTS CO.
Clinton, Iowa
2 boilers: 25.000 lb./hr. each: 200 lb.

GAS FIRED

BEECH AIRCRAFT CORPORATION
Wichita, Kansas
2 boilers: 180 hp. each: 100 lb.

GULF POWER COMPANY
Pensacola, Florida
1 boiler: 230,000 lb./hr.: 875 lb.

GENERAL TIRE & RUBBER CO.
Waco, Texas
3 boilers: 16,000 lb./hr. each: 190 lb.

MATHIESON ALKALI WORKS, INC.
Lake Charles, La.
1 boiler: 420,000 lb./hr.: 925 lb.

MISSISSIPPI POWER CO.
Hattiesburg, Mississippi
1 boiler: 230,000 lb./hr.: 875 lb.

TIDEWATER ASSOCIATED OIL CO.
Avon, California
2 boilers: 100,000 lb./hr. each: 250 lb.

ABERCRAMBIE-HARRISON OIL CO.
Sweeney, Texas
4 boilers: 100,000 lb./hr. each: 250 lb.

PULVERIZED COAL

BELTON MILLS
Belton, South Carolina
1 boiler: 60,000 lb./hr.: 250 lb.

BOECKELER ASSOCIATES
Trenton, Michigan
1 boiler: 528 hp.: 125 lb.

GEORGIA POWER COMPANY
Harryat, Georgia
1 boiler: 600,000 lb./hr.: 975 lb.

HARTFORD CITY PAPER COMPANY
Hartford City, Indiana
1 boiler: 80,000 lb./hr.: 325 lb.

CLINTON ENGINEERING WORKS
Oliver Spriggs, Tenn.
1 boiler: 750,000 lb./hr.: 1375 lb.

N. Y., N. H. & HARTFORD R. R. CO.
Cos Cob, Conn.
1 boiler: 150,000 lb./hr.: 325 lb.

PRATT & WHITNEY
East Hartford, Conn.
2 boilers: 20,000 lb./hr. each: 175 lb.

OIL FIRED

BAY REFINING CORP.
Bay City, Michigan
1 boiler: 350 hp.: 245 lb.

FITCHBURG GAS & ELEC. LIGHT CO.
Fitchburg, Mass.
2 boilers: 120,000 lb./hr. each: 200 lb.

PHILADELPHIA NAVY YARD
Philadelphia, Pa.
2 boilers: 130,000 lb./hr. each: 175 lb.

CITIES SERVICE REFINING CORP.
Lake Charles, La.
4 boilers: 140,000 lb./hr. each: 250 lb.
2 boilers: 200,000 lb./hr. each: 250 lb.

KADOTA FIG ASSOCIATION
Merced, California
1 boiler: 505 hp.: 155 lb.

HIGGINS AIRCRAFT, INC.
New Orleans, La.
2 boilers: 75,000 lb./hr. each: 180 lb.
2 boilers: 40,000 lb./hr. each: 180 lb.

UNDERFEED STOKERS

EDWARD G. BUDD MFG. CO.
Philadelphia, Pa.
3 boilers: 100,000 lb./hr. each: 150 lb.

CHEVROLET MOTORS
Bay City, Michigan
1 boiler: 600 hp.: 150 lb.

INDEPENDENT PNEUMATIC TOOL CO.
Aurora, Illinois
1 boiler: 300 hp.: 300 lb.

THE OLD QUAKER CO.
Lawrenceburg, Indiana
2 boilers: 500 hp. each: 160 lb.

REO MOTORS, INC.
Lansing, Michigan
1 boiler 40,000 lb./hr.: 260 lb.

U. S. FINISHING CO.
Norwich, Conn.
1 boiler: 40,000 lb./hr.: 165 lb.

UPJOHN COMPANY
Kalamazoo, Michigan
1 boiler: 40,000 lb./hr.: 160 lb.

COLUMBUS ASF DEPOT
Columbus, Ohio
1 boiler: 26,000 lb./hr.: 90 lb.

WRITE FOR DATA BOOK NO. S-21

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

"With the splendid service we get from Hagan, we can't afford to install any other control"

The order for Hagan Automatic Combustion Control on the new boiler in this Midwestern power plant came to us without formal issuance of specifications and without competitive bidding.

"We're giving you this order," the plant engineers told us, "because of the splendid service you have given us on the Hagan Control you installed for us several years ago."

That pleased us—but it surprised us also, for our records showed nothing particularly unusual from our standpoint. Our district representative had visited the plant, not especially frequently, but when he knew that a checkup might be useful. On a few occasions he had called in a service engineer.

Between them, however, they had given whatever attention was necessary to make sure that the control continued to function at top efficiency. The engineers appreciated that fact. "When a company shows such a real interest in our plant," they said, "we can't afford to go along with anyone else on our control business."

Well, we are interested—the kind of interest that doesn't stop when the sale is made, but continues as long as the plant is in operation. That interest pays dividends to the user of Hagan Control, for the service men who represent us are experienced engineers. They know combustion control systems—and they also know boiler plant operation. It is their job to help you get the highest efficiency of which your plant is capable.

When you are considering the installation of a combustion control system, send for the Hagan engineer. His experience is at your service.

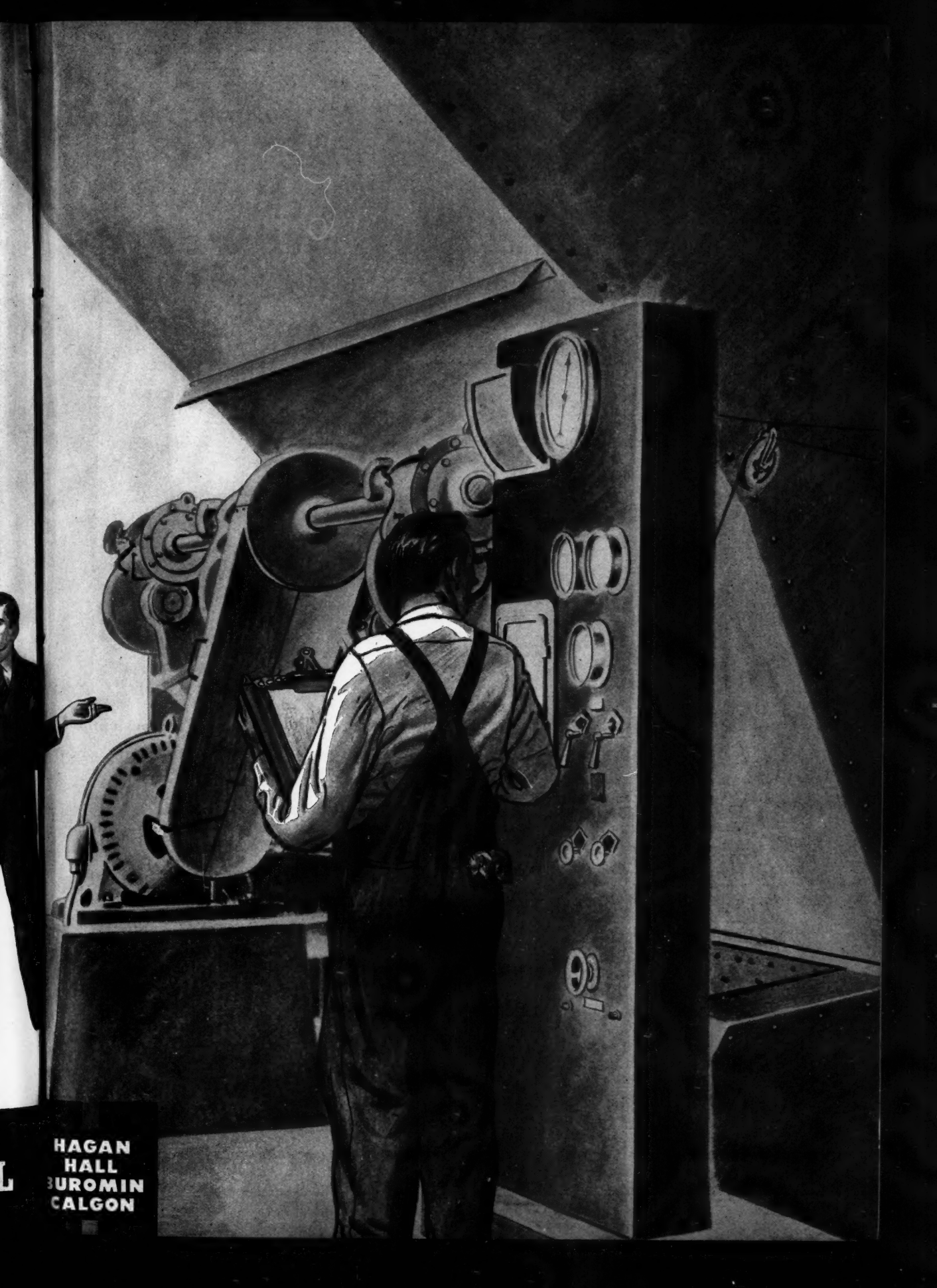
All Hagan Control Systems are designed on the principle that *control* and *metering* are separate functions. Only when these functions are kept independent of each other can control equipment have the dependability, ruggedness, sensitivity and speed of response that are essential for the proper operation of automatic combustion control systems.

HAGAN CORPORATION • HAGAN BUILDING

PITTSBURGH 30, PA.

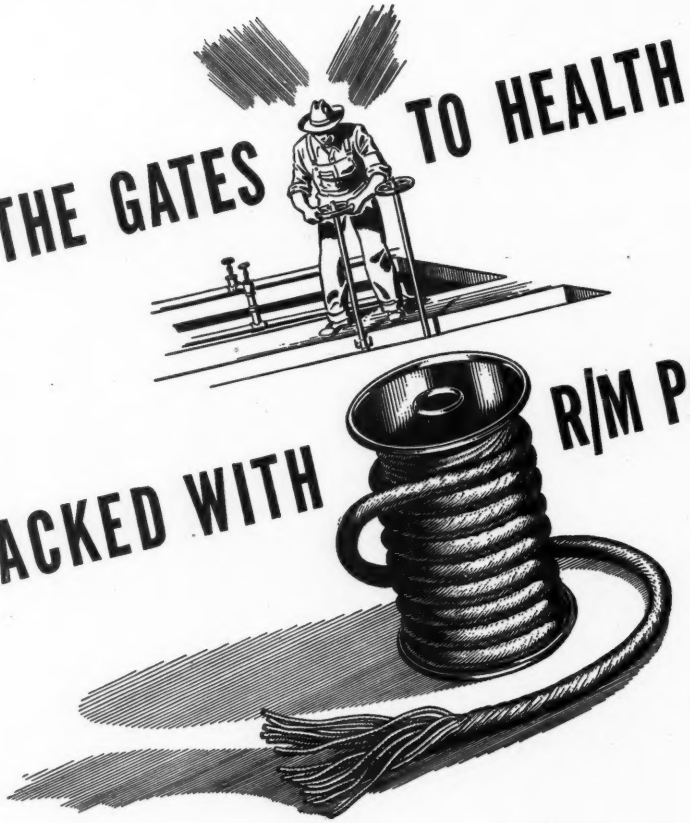
HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader


HAGAN
HALL
BUROMIN
CALGON

OPENING THE GATES TO HEALTH..

VALVES PACKED WITH R/M PACKING



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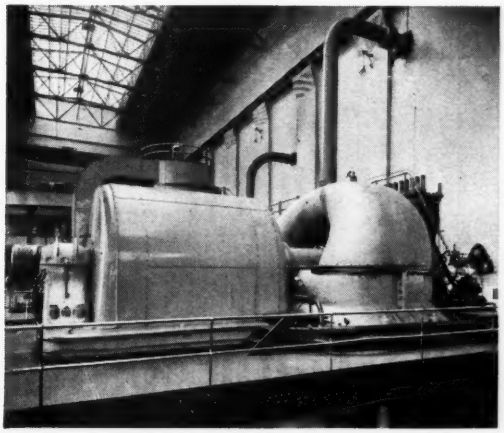
A 13-year record of operation on oxidation-inhibited

NONPAREIL TURBINE OIL



THE 20,000 KW Turbine pictured has operated since 1933 on Nonpareil Turbine Oil without replacing oil, without removing oil for treating, and without cleaning the turbine oil system.

There are reasons behind this typical Nonpareil record—and here they are. Asphaltene formers are removed from Nonpareil during refining, thus eliminating deposit formation caused by oil deterioration. In addition, Nonpareil contains an oxidation inhibitor which prevents acidity formation.

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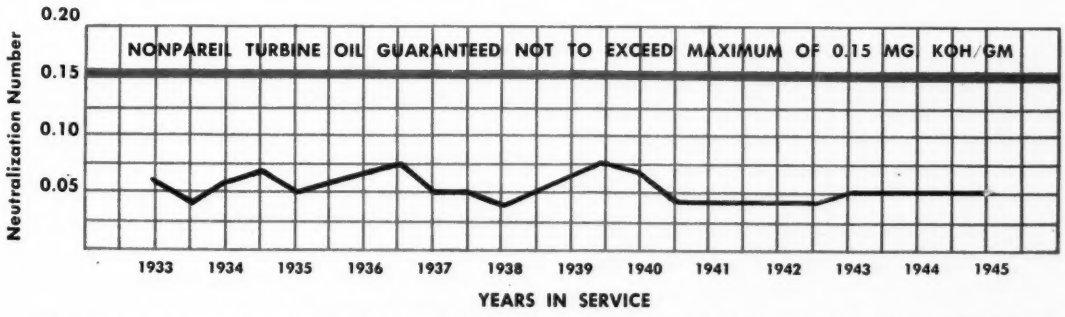

This chart shows the neutralization number (as determined by A.S.T.M. Method D 188-27T), of Nonpareil during 13 years of operation in the 20,000 KW Turbine in a Midwest utility plant. Nonpareil is guaranteed not to exceed 0.15 Mg KOH/gm for the life of the turbine.

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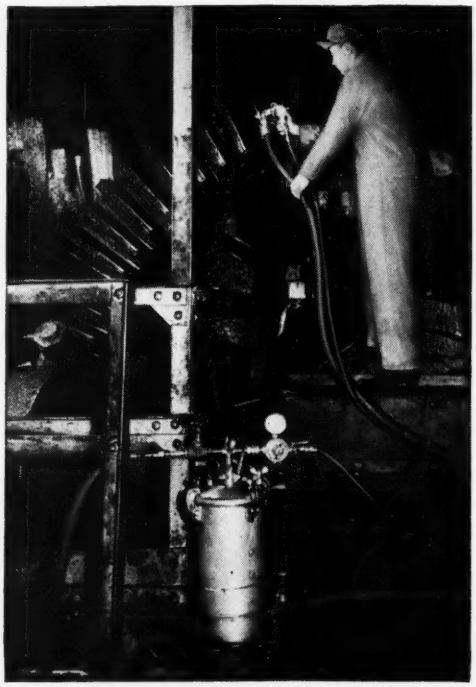
An improved gear lubricant that can be sprayed on gears...



One method of spraying gears is pictured above. Grease under pressure in the tank is carried to the spray gun in the large hose. A separate air hose to the gun provides pressure to break up the grease into a fine spray.

CALUMET Viscous Lubricant

- **Saves time in application**
- **Gives smooth, even film**
- **Reduces frequency of application**
- **Reduces throw-off**

Calumet Viscous Lubricant is not the old type of gear shield usually made from residual products of petroleum. It is a true grease, manufactured from selected soaps and oils plus additives to secure the qualities most needed in a gear shield. In addition, a range of grades is provided, to meet all plant conditions under which gears operate.

That is why Calumet Viscous Lubricant gives the advantages listed above. Because all grades can be applied without heating, and all except the heaviest grade can be sprayed, it cuts application time to the minimum. Spraying also gives a smooth, even coating of lubricant, eliminating bare spots or excessive deposits which may drop off before the lubricant is worked into the gears.

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Let this wear-reducing lubricant protect your plant gears. A Standard Oil Lubrication Engineer will survey your plant and help you determine the grades you need and the most economical methods of application.

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IMPROVEMENTS Make the Difference in Æ Taylor Stokers, Too!

THE NEW Taylor Stoker shatters underfeed stoker tradition. All former designs of "continuous ash discharge" stokers were really intermittent and not continuous. Not content with this arrangement, Æ engineers perfected and now offer two outstanding advancements–

Positive movement of refuse all the way to the tip of the ash discharge plates, assuring continuous fuel bed movement and uniform combustion throughout the fuel bed,

And . . .

Ash discharge opening automatically adjusted to the size of clinkers. Counterweighted ash discharge plates open to allow large clinkers to pass, and then return to normal sealing position.

Check these two outstanding advantages of Æ Taylor Stoker Ash Disposal yourself. See Catalog R-A for all the benefits of Æ Taylor Stokers. Your copy is waiting.

Other Æ Products: Æ-Perfect Spread Stoker, Le-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

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TAYLOR STOKER

AIR-COOLED & WATER-COOLED

The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
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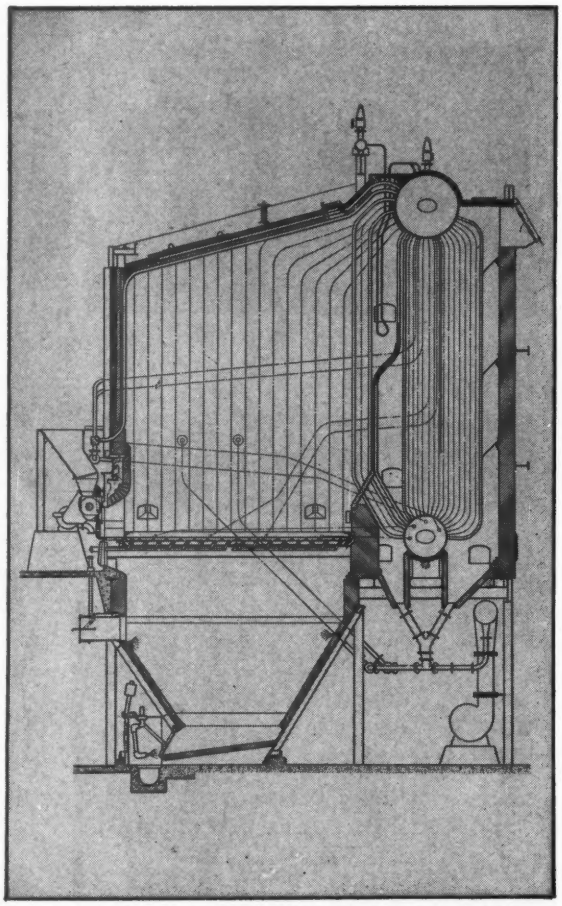
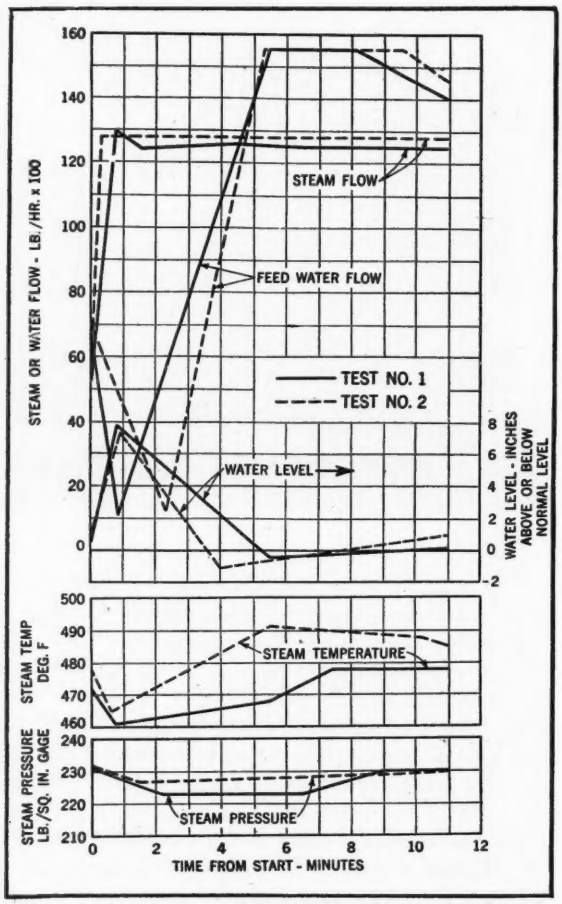
from 53,000 lb of steam per hr



This is the design responsible for the results shown on the adjacent chart. It comprises a C-E Steam Generator, Type VU, fired by a C-E Spreader Stoker. Guaranteed Capacity — 100,000 lb of steam per hr (Maximum Continuous).



The above chart was plotted directly from figures taken from the recording instruments and readings made during the tests. The results of the tests are briefly discussed on the opposite page.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

to 130,000..

...in 40 seconds flat!

During the war Combustion Engineering was asked to design a steam generating unit capable of taking extreme load swings in a matter of seconds... without serious effect on steam pressure or temperature. A number of such units were installed in a "top secret" plant; they combined the VU Steam Generator with the C-E Spreader Stoker.

Then came the tests... tests of the utmost severity to determine just how well these units could handle the job for which they were designed. The results are here charted and briefly described. Not only did the unit more than meet specified performance but the results were all within our predicted limits of variation in operating conditions.

Summary of Test Results

The first test was a brief preliminary that shot the rating from 60,000 to 108,000 lb of steam per hr.

Then followed the first formal test, results of which are plotted as solid lines on the accompanying chart. Load was zoomed up from 53,000 to 130,000 lb per hr in 40 seconds. Maximum temperature drop was 13 deg. F; maximum pressure drop was 9 psi.

They tried it again. Up went the steam demand from 60,000 to 128,000 lb in 20 seconds. (See dash lines on chart.) Same story — pressure drop 5 psi, temperature drop 11 deg. F.

The maximum change in water level under these conditions was a 7.3 inch rise; maximum increase in solids carryover was 1.1 ppm.

On the score of flexibility and load pick up nothing need be added to the foregoing performance figures, but the following paragraph from one of the test reports is significant because it indicates the reserve capacity inherent in C-E Spreader Stoker design — "After the output of 128,000 lb per hr was reached in the second test increase, one distributor unit was taken out of service and the load maintained with the four remaining units. When it became obvious that the load could be maintained with only four units in service and with some stoker capacity still in reserve, the five sections of the fire were cleaned consecutively without the use of any firing tools."

A-971

ENGINEERING

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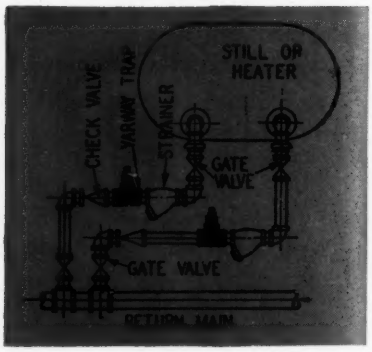

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Users tell us the most convincing salesman of Yarway Impulse Steam Traps is the trap itself. In plant after plant, now 100% Yarway-equipped, the maintenance engineer started with one Yarway trap. In less than ten years nearly half a million Yarways have been bought by utilities, institutions, industrial plants and ship-operating companies. Here are the reasons:

ONLY ONE MOVING PART. No levers, buckets, weights, bellows or floats. The only moving part is a simple valve. Result—Easy maintenance and small inventory of parts.

SMALL SIZE . . . LIGHTWEIGHT. Hardly larger than a pipe union, Yarways require no support other than the pipe line. Installations are simpler, neater, more practical.

GOOD FOR ALL PRESSURES. Yarways are good for all pressures within a broad range without change of valve or seat. Factory set.

EFFICIENT OPERATION. Yarways discharge condensate rapidly, getting equipment hotter, sooner, and maintaining peak efficiency. Small amounts of condensate discharge continuously through control orifice in valve; at medium loads, main valve opens and closes at short intervals; under heavy loads, valve opens wide.

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YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

A National Spokesman for Engineers

By A. B. STICKNEY

UPWARDS of 200,000 engineers in this country are sufficiently interested in engineering as a profession to have joined a society, but not over 10 per cent of them belong to any one society. There is a widely-felt need for an over-all organization of all the societies to act as spokesman for all engineers on matters of common concern. On a local basis over 100,000 engineers in 35 metropolitan areas have organized themselves into Local Councils, and are doing an effective job of intersocietal cooperation within their sphere of activity. In the last few years much has been said and written about a similar organization on a national scale. While it is no longer necessary to talk about why or whether there should be such an organization, there is no such unanimity about what it should be like.

First, **who?** It should be built on the foundation that the American Standards Association has so effectively employed, that anyone having a legitimate interest has an inherent right to participate. There are five types of organization which have that legitimate interest. They are:

1. The so-called Founder Societies — Civil, Electrical, Mechanical, Mining and Metallurgical, and, included in recent years, Chemical Engineers.
2. The specialized National Societies. The Agricultural, Automotive, Heating and Ventilating, Illuminating, Radio, Refrigerating, Tool and a host of other Engineers, all have their own societies.
3. Local specialized groups, similar to the specialized national societies but not organized on a national scale.
4. The Local Councils, which are composed of the Local Sections of National Societies and of Local Groups, so that membership is by virtue of membership in some other organization.
5. The local Engineering Societies or Engineers Clubs, which have individual membership but which cut across the field, have members with various specialties.

Trade associations or organizations having predominantly Company memberships should definitely not be included. Whether technologists in other fields than engineering should be included is a moot point, but that is something for them to decide.

Second, **how?** A governing body for a national organization would be formed by having each member body select one representative for a period of three years, with the larger organizations having more than one representative, say on a basis of major fractions of 5,000. Terms would be staggered so that one third were elected each year. These men would form the National Council. It would elect its own officers and the members of standing committees. The Council would meet twice a year, and between times an Executive Committee would give effect to its decisions.

There would be a Standing Committee in charge of each activity the Council undertook. Additional activities could be undertaken, and additional Standing Committees formed to supervise them, by say two-thirds vote of the entire Council membership at two successive meetings, which would mean that any controversial points could be discussed by the governing bodies of the member organizations, and their representatives instructed, before a final vote.

Third, and most important, **what?** This is the point where most of the disagreement occurs. There are many things the National Council might concern itself with, and some of them will be enumerated shortly. But what do the majority of engineers—the men the Council will be spokesman for—want? Nobody knows, and nobody can know. The issues have never been laid before them—there is no mechanism for doing it. And right there is the answer to the question.

Create the mechanism, lay the issues before them, and find out what they want!

What is the mechanism for finding out what is wanted? It is to start a magazine which will go to each of the individual members of each of the member organizations, by virtue of that membership, in addition to the publications of his own organization. Discuss the issues—present both sides—and let the membership of the various Societies tell their representatives what they want.

The magazine would be divided into four main parts. The first part would be the policy articles—the social and economic status of engineers, licensing, collective bargaining, engineering education, pending legislation.

The second part of the magazine would be informative articles on engineering matters of general interest: what is going on in the engineering world outside of their own fields of specialization—such things as regional planning; flood control; super-highway system integration.

The third part of the magazine would be the news of the organization and of the member organizations, and of engineers individually.

The fourth part of the magazine would be a combined index of the technical parts of the publications of all member societies, so that the individual engineer could find out about articles of interest to him in journals he does not normally see.

Finally, **who is going to pay for it?** Let each member group pay a $1 subscription to the magazine for each individual member. Where a man is a member of more than one group, split the dollar. Where membership in one group is by virtue of membership in another group which is already in the National Council, there would be no charge. Beyond that, advertising will pay for it.

In conclusion, the ASRE Council has authorized the writer to sit on an Organizing Committee to give effect to such a scheme, and it has made an appropriation to help defray the expenses of such a committee. A number of other groups have been invited to do likewise, and it is quite possible that such a committee will be functioning within the next few months.

A. B. Stickney has been Engineer on the staff of Armour & Co. in Chicago since 1936 and was president of the ASRE in 1944. He was graduated in 1923 from Yale University, then did three years of graduate work in the fields of power and refrigeration. From 1926 to 1934 he was on the staff of Fred Ophuls and Associates; he then spent a year with Armour & Co.; next served for a year with Tennessee Eastman Co. at Kingsport; and returned to Armour & Co. in 1936, where he has been ever since. He has been appointed chairman of the ASRE Committee on Relations with Other Organizations. He presents here a perfectly definite proposal for action on a matter that engineers have discussed for a long time. What do you think of this plan?

Southwark Station to Have

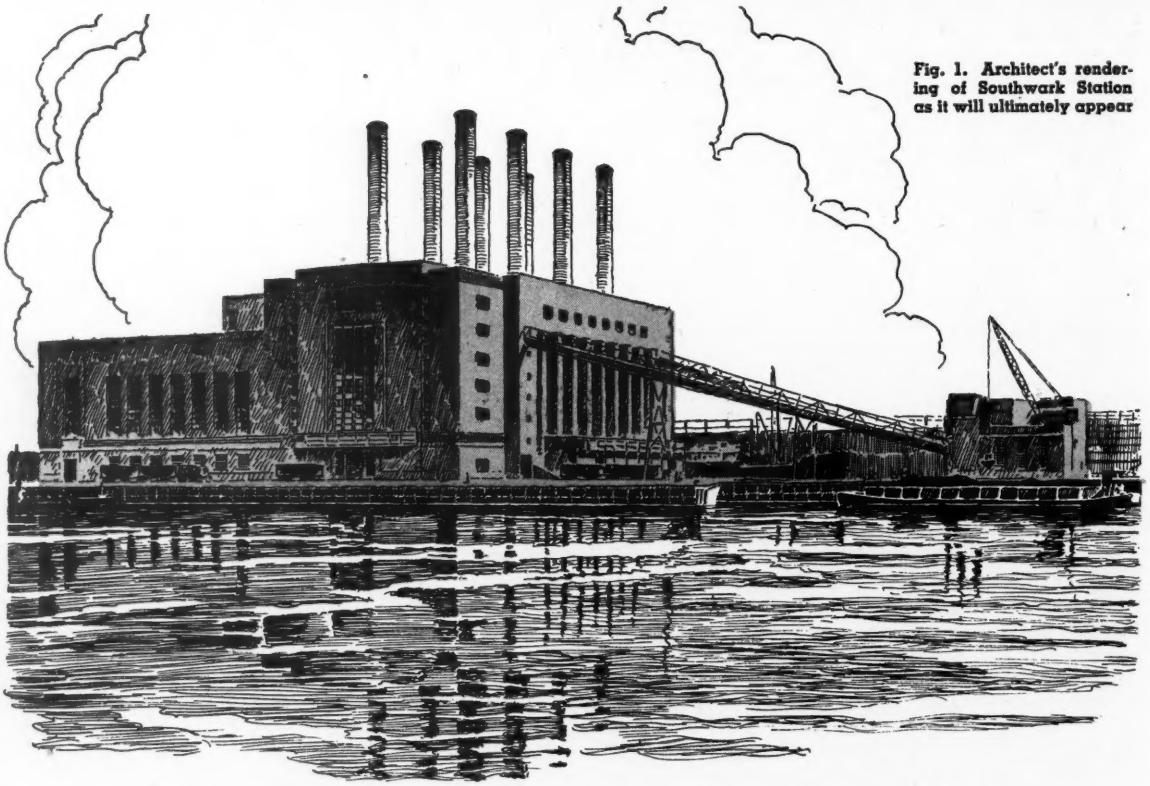


Fig. 1. Architect's rendering of Southwark Station as it will ultimately appear

NEWEST ADDITION to the production plant capacity of Philadelphia Electric Co. is to be Southwark Station. Present plans for this station provide for the installation of two 150,000-kw, 0.8-pf cross-compound turbo-generators, each to be supplied by two 850,000-lb-per-hr pulverized-coal-fired boilers. Steam conditions will be 850 psig and 900 F. Each turbo-generator supplies two sections of a four section, 13.8 kv ring bus. Associated with each main turbo-generator there will be an auxiliary unit of 12,500-kw 0.8-pf capacity. The first of these units is scheduled for service in the fall of 1946 and the second about a year later. The plant will be built according to a strictly unit arrangement. That is, each unit will be self-contained, there being no steam or feedwater connections between units. For a detailed description of the plant and for discussions of the mechanical and electrical design problems, the reader is referred to current articles in other technical magazines, as listed at the end of this article.

General Considerations

The matter of an auxiliary power source for this station has been the subject of serious consideration for a number of reasons:

1. The capacity of this station will represent a very substantial portion of the system capacity. Therefore, reliability of operation was placed at the top of the list of design objectives.

2. This will be the first Philadelphia Electric Co. station to be completely pulverized-coal-fired, and it was realized that even a momentary loss of auxiliary power would put out the fires for about one-half hour due to the need for purging the furnaces before re-igniting.

3. It was decided that, except for the first start and for troubles almost the equivalent of a station wreck, the station should be capable of preparing to carry load without outside assistance.

4. Experience had been obtained wherein a cable fault, external to a station, had caused a voltage dip sufficient to "shake off" essential auxiliaries where the auxiliaries were supplied from the station bus.

Schemes Considered

At least three schemes for supplying auxiliaries were considered. These, with their advantages and disadvantages in the light of the above, were as follows:

First was the scheme which was first employed by Philadelphia Electric Co. in 1925 at the then new Richmond Station and which consisted in tapping the generator leads to supply a so-called "stub bus" through a step-down transformer. The essential turbine plant auxiliaries, such as circulating pumps and boiler feed pumps, were connected to this bus. Inasmuch as there were a large number of stoker-fired boilers connected to a common header system, the boiler auxiliaries were connected to the regular station light and power bus. To make it possible to start the plant if it became separated from the system simultaneously with the loss of the main units, a small, quick-starting, emergency auxiliary generator was provided.

This arrangement has worked very satisfactorily but it was felt that it contained at least two inherent weaknesses in the light of what was desired at Southwark: first, system voltage disturbances could "shake off" the auxiliaries if of sufficient duration; and second, if the main unit were to become suddenly separated from the system and the fires were extinguished at the same time or the unit tripped on overspeed, the stored heat in the boilers would probably not be sufficient to turn the main unit long enough to get the fires started.

The second scheme was to use separate auxiliary generators connected to the main unit shafts, instead of the "stub-bus" transformers. Such a plan would eliminate the likelihood of trouble due to system disturbances

Separate Auxiliary Generators

By
J. H. Harlow
Assistant Mechanical Engineer
and
F. R. Ford
Assistant Engineer, Inside Plant, Electrical Engineering Division
Philadelphia Electric Company

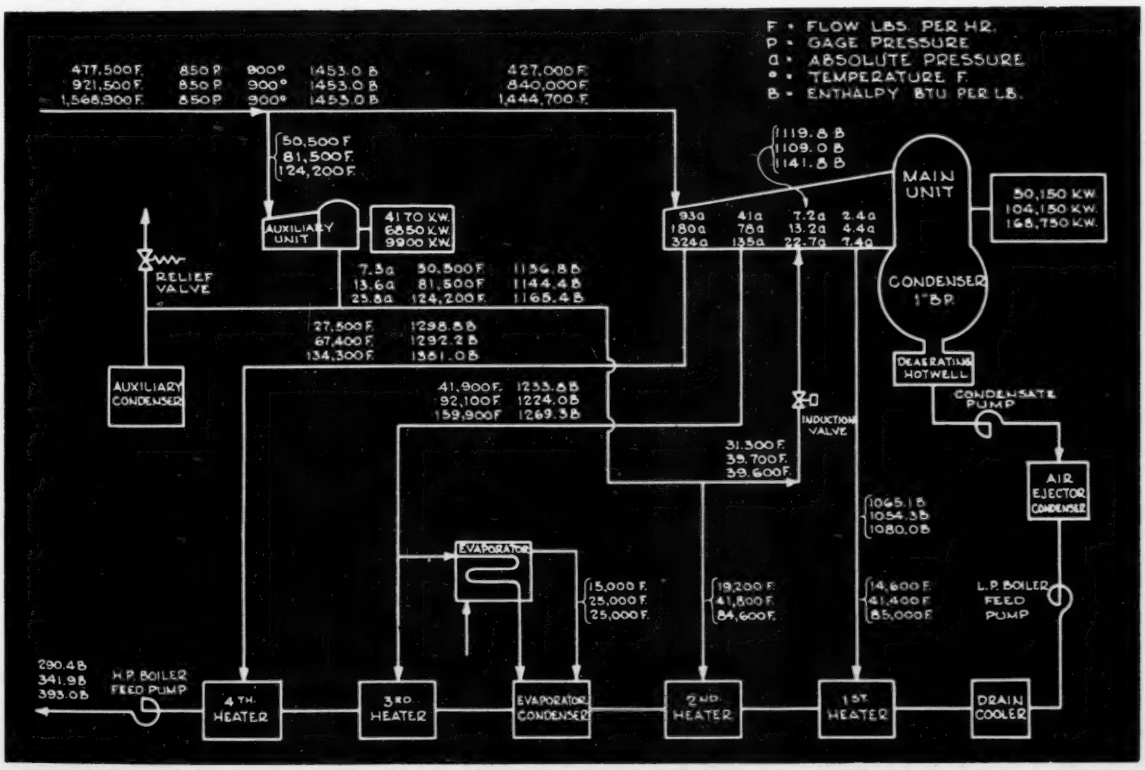
Here is a detailed analysis of the reasons why separate auxiliary turbo-generators are being installed in the new Southwark Station of Philadelphia Electric Co., Philadelphia, Pa. . . . Discussion of factors leading to this scheme rather than to obtaining auxiliary power from main generator leads or from generator connected to main unit shaft . . . How separate auxiliary unit affects station heat balance . . . Details of electrical circuits for auxiliary supply; combustion control bus; radial supply system and why it was selected; voltage selection; motor ratings; control and protection . . . First unit of station to be one 150,000-kw cross-compound turbine generator, supplied by two 850,000-lb-per-hr, 850-psi, 900-F, pulverized-coal-fired boilers

but would not avoid the possibility of being unable to start due to loss of boiler steam pressure. In other words, it only accomplished half a job. Separation would be complete on the electrical side only, potential steam difficulties being as real as with the first scheme.

The third scheme comprised separate turbo-generators installed solely for the purpose of supplying power to the essential auxiliaries. This arrangement was adopted, because it provided a means of completely separating the auxiliary power source from the system both on the steam and electrical ends. Thus, even though the main unit were to lose its load suddenly and trip out, there is no reason to believe that the auxiliary unit would be simultaneously and similarly affected. Even if, under some extreme set of circumstances, the fires were to be extinguished at such a time, the low steam requirements of the auxiliary turbine in comparison with that of the main unit could permit it to be operated for a substantial time on stored heat in the boiler.

It was realized that the emergency loss of the auxiliary unit would shut down the main unit. Emergency losses, however, of the type where nothing can be done about it are rare occurrences. Arrangement has been made for an alternate source to the auxiliary generator busses from the main station 13.8-kv bus. The likelihood is remote, therefore, of a simultaneous loss of the auxiliary generator and of the alternate source, or of a type of trouble in which insufficient time would be available for transferring to the alternate source. Even if this remote occurrence developed, it is almost inconceivable that the loss of one electrically-independent aux-

Fig. 2. Schematic diagram of bleeder and auxiliary turbine arrangement at Southwark Station, showing how auxiliary unit will be connected into main unit heat cycle



Why Separate Auxiliary Generators for Southwark?
1. Station capacity a substantial proportion of system capacity, hence reliability was prime objective.
2. This is the first all-pulverized-coal-fired plant of company and momentary loss of auxiliary power might cause loss of fires and delay due to need for purging furnaces.
3. Station should be capable of preparing to carry load without outside assistance.
4. Experience had been encountered in which cable fault outside station caused voltage dip that "shock off" station auxiliaries supplied from station bus.
Therefore separate auxiliary generators were chosen because they provided a means of completely separating auxiliary power source from system on both steam and electrical ends.

iliary turbo-generator would be associated with a system disturbance or with the loss of another main unit and its auxiliary turbo-generator.

The Southwark Arrangement

Each auxiliary unit at Southwark, one of which will be associated with each main unit, will be rated at 12,500 kw, 0.8 pf, 4,000 v. Figure 2 shows the manner by which it will be connected into the main-unit heat cycle. This scheme is patterned after one which was developed for Chester Station and which has been proved satisfactory by over three years of operation. At Chester, three steam-driven, high-pressure boiler feed pumps were installed in conjunction with a topping unit installation and their exhaust used for feedwater heating in lieu of non-existent bleeder connections on the old low pressure units. Subsequently, a new low-pressure unit was added with the normal complement of bleed openings, and the boiler feed pump turbine exhaust was connected with one of the bleed points to jointly supply the steam for one stage of feedwater heating.

At Southwark the auxiliary turbine was located in the heat cycle in a manner similar to that employed for the turbines of the high-pressure boiler feed pumps at Chester. This provides an arrangement which has a very minor effect on the net heat rate of the station and makes it possible to supply virtually all of the rated capacity of the main unit to the out-going lines. A comparison between the cost of this scheme and the first scheme outlined above indicated that the auxiliary unit could be installed at a net increase in cost, referred to the capacity gain, of about 50 per cent of the average overall station cost per kilowatt. The use of an auxiliary unit, arranged in this manner, complicates the heat cycle and the station electrical system to a certain extent. This increased complication, however, is considered to be justified by the assurances of more dependable auxiliary power supply.

Connection of Auxiliary to Main Unit

Referring again to Fig. 2, it will be noted that the throttle steam conditions for the auxiliary unit are identical with those for the main units. The exhaust, on the other hand, under the normal operating setup will be connected to the second lowest level bleed connection of the main unit. Under this condition, the auxiliary unit exhaust pressure will be a function of the load on the main unit. In general, the quantity of the auxiliary unit exhaust will be greater than required by the second heater. Therefore, there will be a flow of steam into the main unit at this bleed connection, and this steam will flow through the remaining main-unit stages to the main unit condenser.

In this manner, all of the auxiliary-unit exhaust steam is recovered either in the form of heater drains or as main unit condensate, and, in effect, the auxiliary turbine may be regarded as providing a steam path parallel to that of the main unit as far as the second bleed point. Figure 2 also shows the calculated flow rates and conditions pertaining at three loads. For completeness the estimated condition within the main unit at the second bleed point is shown. It will be noted that the engine efficiency of the auxiliary unit is within better than 90 per cent of that of the main unit over the same pressure range, with the result that the effect of using this arrangement on the overall net efficiency of the plant is slight.

In addition to the normal arrangement for tripping the throttle valves on overspeed, the Southwark main units are equipped with an overspeed trip valve in the second bleed line. Such a valve is required in order to eliminate any possibility of overspeeding the main unit due to steam entering by way of the auxiliary unit exhaust. This valve has been called the "induction" valve. In order that the auxiliary unit may continue to operate when the "induction" valve trips, a relief valve to the free exhaust stack has been provided in its exhaust line.

There will be periods when it will be desirable to operate the auxiliary unit independently of the main unit. For operation during such periods an auxiliary unit condenser has been provided. This condenser is arranged only for the purpose of recovering condensate and has not been designed to produce vacuum for efficiency. Cooling water for the auxiliary unit condenser will be supplied by the plant's river water system.

Electrical Features

The schematic arrangement of the auxiliary power supply system is shown in Fig. 3. Each auxiliary turbo-generator will supply two auxiliary power bus sections, to each of which will be connected all of the auxiliaries, such as fans and pulverizers for one boiler and about one-half of the auxiliaries such as condensate and boiler feed pumps for the main unit. The miscellaneous plant auxiliaries such as air compressors, coal handling equipment, station lighting and house water pumps will be supplied from two station service bus sections each of which will be fed normally by a 10,000-kva transformer bank stepping down from the main station 13.8-kv ring bus. There will be ties between the auxiliary power busses and station service busses for use in starting and during periods of outage of the auxiliary unit. Normally these ties will be open in order to safeguard the auxiliary power supply from disturbances on the main station buses.

Combustion Control Bus

There are certain devices, particularly in the control system associated with the boilers, which it is extremely desirable to continue in service subsequent to loss of boiler auxiliary power, in order that the boiler may be taken off the line safely. Most of these devices are associated with the combustion control and all are electrically driven; therefore, each boiler is equipped with a 115-v "combustion control" bus. The normal source for this bus is from its corresponding 4-kv auxiliary power bus. Should the normal source be interrupted, an automatic throw-over switch will operate to change the source to the 4-kv auxiliary power supply bus of the other boiler.

Boiler feed and condensate pumps for each main unit are installed in triplicate, one being a spare. Two of each, designated "A" and "C," are supplied from only one auxiliary power bus. The third, or "B" pumps, may be supplied from either auxiliary power bus as selected. These pumps are automatic in operation.

In designing the auxiliary power system for Southwark, certain basic principles were adhered to in the electrical arrangement which are believed to be of particular importance, including the following:

1. The supply circuits to auxiliaries of individual units should not be crossed, in violation of unit principles;
2. Duplicate auxiliaries should be supplied from independent sources;
3. Auxiliary power busses should be physically segregated by being located in separate rooms with non-communicating ventilating facilities.

Power Requirements

Under normal full load conditions, the load on each auxiliary power bus will be approximately 7300 kva, resulting in a total load on the auxiliary generator, from which they will both be supplied, of 14,600 kva. The normal load on each of the two station service busses will be 1100 kva with the first generating unit, and with an additional load of 150 kva each when the second generating unit is installed.

Basic Principles of Auxiliary Electrical System Design

1. Supply circuits to individual units should not be crossed in violation of unit principles.
2. Duplicate auxiliaries should be supplied from independent sources.
3. Auxiliary power busses should be physically segregated by being located in separate rooms with non-communicating ventilating facilities.

Radial distribution system for auxiliary power was selected because it had been proved reliable and simple in other stations of company and carried out segregation principle.

Combustion control bus supplies devices associated with combustion control, so boiler can be taken off line safely.

With an auxiliary generator out of service, the main station service transformer may be called upon to carry the combination of the station service load and the auxiliary power load totalling 8550 kva; for brief emergency conditions, the bank load may reach a total of 10,800 kva.

Radial Supply System

In determining the type of distribution system for the Southwark auxiliary power, consideration was given to the relative reliability and cost of the radial and network types of system. Different types of network were studied, in view of the fact that this network system has indicated a greater reliability than the radial system both in urban areas and in individual plants. However, as far as the 4-kv system at Southwark is concerned, parallel operation of the various sources as required with a network would defeat the principle of segregation of the important auxiliary supplies from the station main bus.

For the 440-v system, a network arrangement would seriously increase the fault current duties on circuit breakers and fuses. It would be of no special value for the case of a motor failure, or of the individual cable associated therewith, which constitute the most common types of failure in the auxiliary system. Furthermore, with duplicate auxiliaries as have been provided for all of the more important services, the normal advantages of the network become relatively unimportant.

The experience with radial systems in existing stations of the Philadelphia Electric Co. has been entirely satisfactory. In view of the proven reliability and of the appreciably greater simplicity with the radial system, it was decided to use this arrangement at Southwark.

Voltage Selection

A comparison was made of the primary distribution voltages of 2.4 and 4 kv. The capacities involved for some of the circuits made the lower voltage rather difficult to use because of the relatively high currents involved. For instance, on the auxiliary generator circuit, the lower voltage would require a current of 3800 amp as against 2200 amp at the higher voltage. In the case of the two source transformer banks, the 2400 amp involved at 2.4 kv would require either a special circuit breaker or two circuit breakers in parallel, either of which is quite undesirable. The cable size required for some of the larger motors with the size running up to 1500 hp would be rather excessive.

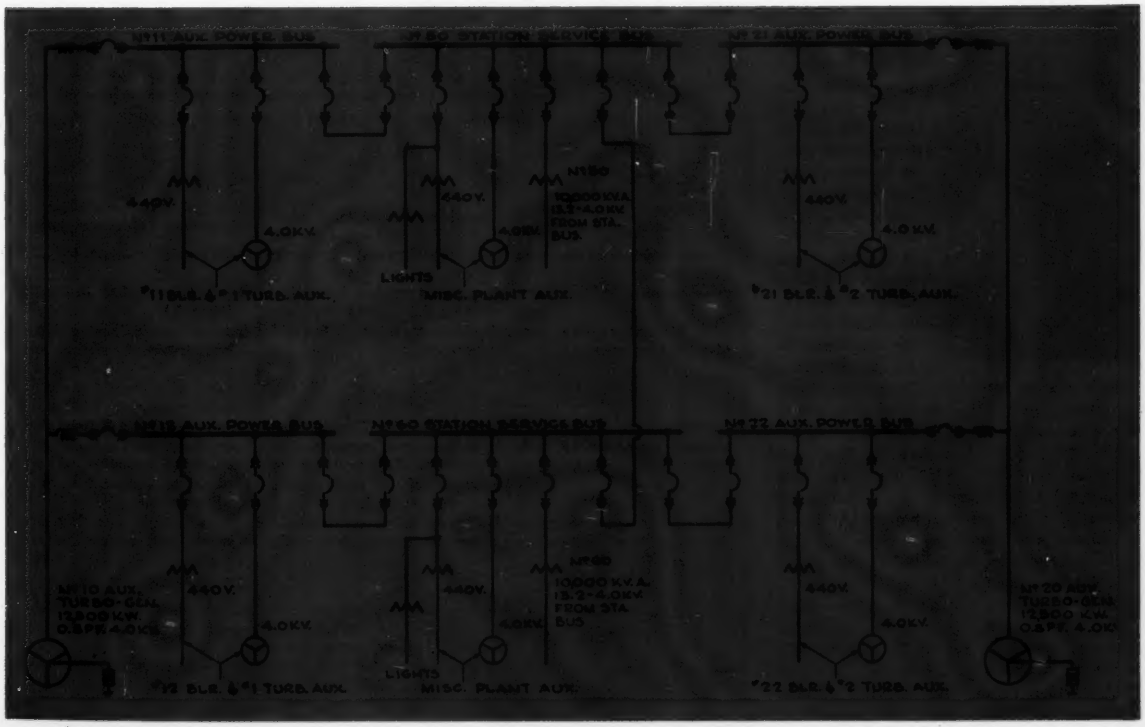
An economic comparison of the two voltages indicated a substantial saving with the use of 4 kv, with no particular disadvantage from an operating or a safety standpoint. A definite advantage of the higher voltage is the lower starting voltage drop involved for the larger motors, all of which will be full voltage starting.

For the low voltage system, consideration was given to 220, 440 and 550-v, 3 phase. It was determined that the 440-v system would be substantially less expensive than the 220-v system. The use of 550-v would give a slightly cheaper system than 440-v, but appeared somewhat undesirable from the standpoint of availability of manufacturers' standard equipment.

Apart from the economic advantage, the principal merit of the 440-v system as compared with the 220-v system is that it minimizes the problem regarding breaker and fuse duty, which is somewhat difficult at the lower voltage. There is also a question of space involved, in that 25,000-amp interrupting capacity breakers, which are adequate at the higher

(Continued on page 116)

Fig. 3. Schematic arrangement of auxiliary electric power system at Southwark Station



Practical Information Concerning Steam Turbine Lubricating Oil

1. Steam turbine lubricating oils are referred to as old and new types.
2. Contrasting differences in characteristics of old and new types are pointed out.
3. Stabilities of lubricants are compared in curves and table.
4. Corrosive qualities of oils acting on metal are illustrated.
5. Corrosion prevention methods which have been used are enumerated.
6. Qualities of turbine lubricating oil required by operators are pointed out.
7. Influential factors in the deterioration of oil are discussed.
8. Requirements of a satisfactory lubricating oil system.
9. Routine care of oil while in service to insure safety, long life and efficient lubrication.
10. Tests suggested as means of more accurately predicting oil failure.

By S. F. WHIRL

Chief Chemist, Power Stations Department, Duquesne Light Co., Pittsburgh, Pa.

RAPID ADVANCES made in recent years in the development of improved steam turbine oils have caused much discussion about old and new-type lubricants; unfortunately, too, there has been some double talk. Although both types conform to the same, broad, new oil specifications issued by turbine manufacturers, they vary widely in their behavior in service. Their general characteristics are compared in Table I. In this paper, the author points out the differences in these oils and discusses in some detail the practical aspects to be considered in their selection, evaluation and maintenance.

In general, the oils now referred to as old-type are those of a decade or more ago. While excellent lubricants, they were characterized by their instability in the oxidizing environment of the turbine system, and consequently, pronounced sludging was quite common. Complete changes of oil with thorough system cleaning were necessary at comparatively frequent intervals. An example of the deterioration in service of an oil of this type, as indicated by the rise in Neutralization Number (acidity), Steam Emulsion Number, and Viscosity is shown in Fig. 1.

In contrast the new-type oils are known for their high oxidation stability and negligible sludge-forming characteristics. These qualities were obtained by new methods of refining which largely removed the more readily oxidizable constituents and by the addition of certain materials which inhibit the normal oxidation

The author of this article has had wide and varied experience in the field of chemistry. Following his career at Ohio State University, where he was awarded the degree of A.B., M. Sc., and Ph.D., he was employed by Eastman Kodak Co. as Research Chemist in 1928. A fellowship at Ohio State was followed by employment at Duquesne Light Company, Pittsburgh, as a chemist. This position he held until 1937 when he was appointed Chief Chemist. Dr. Whirl is co-author of many technical papers and holds membership in five of the leading technical and engineering societies—Chairman of the Power Stations Chemistry Subcommittee, Prime Movers Committee, Edison Electric Institute; member: American Chemical Society, American Society for Testing Materials, Engineers Society of Western Pennsylvania and the National District Heating Association.

Table I. Comparison of General characteristics of old and new-type turbine oils

OLD-TYPE OILS	NEW-TYPE OILS	
No Inhibitors Added	Oxidation Inhibitors Added	Oxidation and Corrosion Inhibitors Added
[illegible] with respect to oxidation. Sludge forming.	Stable with respect to oxidation. Negligible sludge formation. (Note 1.)	Stable with respect to oxidation. Negligible sludge formation. (Note 1.)
Acidity increases rather rapidly with service.	Acidity remains low with service.	Acidity remains low with service. (Note 2.) When acidity is slightly higher than that of oils containing only oxidation inhibitors
Steam Emulsion Number increases gradually with service.	Steam Emulsion Number may or may not increase with service, depending on brand of oil and system in which used.	Steam Emulsion Number may or may not increase with service, depending on brand of oil and system in which used. (Note 2.)
Excellent rust-preventing characteristics develop with service.	No appreciable rust-preventing characteristics develop with service.	Possess rust-preventing characteristics, at least temporarily. Corrosion inhibitors are still in the experimental stage.

Note 1. Several cases of sudden and rapid sludging have been reported—attributed to depletion of oxidation inhibitor.

Note 2. In general, values are slightly higher than those of oils containing only oxidation inhibitors.

Table II. Analyses of a new-type oxidation-inhibited on when new and after seven years service

	When New	After 7 Years
Gravity, API°	32.7	32.8
Pour Point, °F	0	10
Flash Point, °F	405	405
Fire Point, °F	460	450
Viscosity (SUV) at 100°F sec	152	155
at 210°F sec	44	44
Steam Emulsion Number, sec	15	90
Color, ASTM No	—	2½ minus
Precipitation No. ml	—	Trace
Sediment and Water, % by vol	0	Trace
Neutralization Number, mg. KOH/g. oil	0.02	0.05

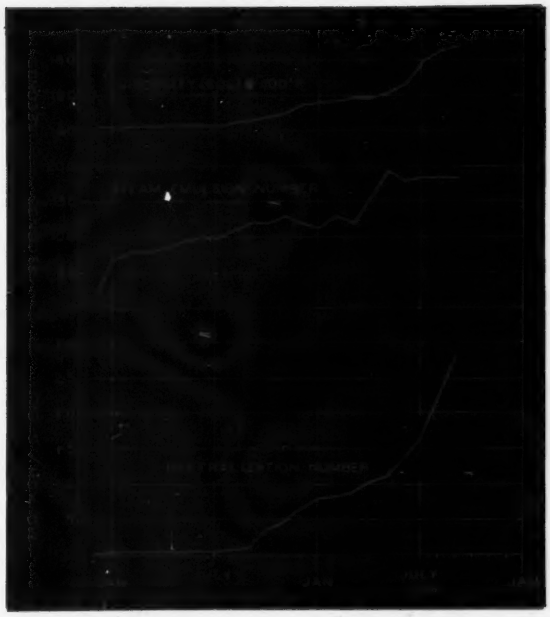


Fig. 1. The chart at the right shows an example of the deterioration in service of an oil of the old type as indicated by the rise in neutralization number (acidity), steam emulsion number and viscosity

reactions. Variously known as additives, antioxidants and oxidation inhibitors, their presence in amounts as small as a few tenths or even a few thousandths, of one per cent, effectively forestalls failure of the oil. The stability of such a new-type lubricant is demonstrated by the data of Table II. It is to be noted that its properties after seven years of almost continuous service are approximately the same as those of new oil. This service period is roughly four times that of the old-type oil of Fig. 1.

Concurrent with the introduction of the highly stable oils, equally serious troubles of an entirely different nature were experienced. Pronounced corrosion of the metal surfaces was caused by the moisture inevitably present in varying amounts in every turbine system. This led, in some cases, to restriction of oil passages and abrasion of the bearings and governor parts by the corrosion products. It is now generally recognized that in the removal or conversion of those constituents that were so readily oxidized, something was taken out that gave oil films the capacity to immunize a metal against rusting. To prevent such corrosion, three methods have been tried with varied results: (a) the admixture of old rust-preventing oil with new oil; (b) the internal painting of the oil system surfaces; and (c) the use of corrosion inhibitors. Typical of the varied rust-preventing characteristics of different oils are the test results shown in Fig. 2.

Selecting a Turbine Oil

To the operator the right turbine oil is one which assures the maximum in dependable, trouble-free service. From his point of view, the oil is a medium for adequate and efficient lubrication, effective cooling, and hydraulic actuation of the governor mechanism. These purposes can be served only if the oil (a) has the physical properties consistent with the specific pressure - temperature-speed conditions, (b) is highly resistant to foaming and emulsification, (c) is chemically stable, and (d) can protect all metal surfaces against corrosion.

While the operator knows what he wants, it is not surprising that he is often perplexed in making the selection. He recognizes that oil themselves differ in nature and that the use of inhibitors is still in the experimental stage; particularly is this true of corrosion inhibitors. In view of this confusion, it would appear that his safest gamble is to purchase the oil on specifications which tend to establish its properties and probable behavior in service and if possible to select an oil known to have given good service under similar operating conditions.

New oil specifications usually include tests for Viscosity, Flash, Fire and Pour Points, Neutralization and Steam Emulsion Numbers, and Water and Sediment. In some instances, these are supplemented by laboratory oxidation (life) and corrosion inhibition tests. The procedures normally used for these tests are those published by the American Society for Testing Materials. Obviously, the specifications must always conform with design data.

Chemical Stability

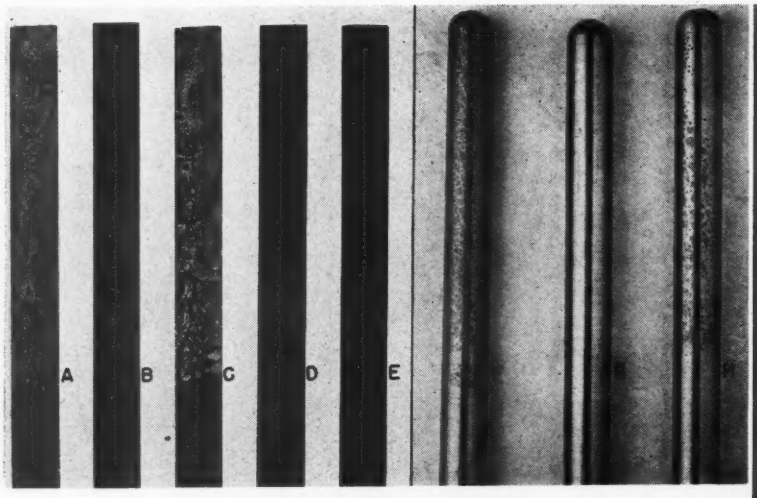
The four most influential factors in the deterioration of an oil are oxygen, heat, moisture and metals; significantly, all of them are inherently present in every turbine system. With the thorough aeration experienced by the rapidly circulating oil, an abundant supply of oxygen is continuously in intimate contact with the lubricant. The effects of aeration are largely regulated by the temperature; with each 20 F increase, the oxidation rate is approximately doubled. In turbine operation, considerable heating is obviously unavoidable, but the maintenance of oil temperatures at the minimum values consistent with the other practical considerations will tend to retard oil failure.

Moisture, normally present in the system in at least trace quantities, also greatly accelerates the reaction with oxygen from the air; the action is as much as ten times as fast in the presence of moisture. Water appears also to have a special faculty for causing the oxidation products to precipitate as sludge. The influence of metals on the oxidation mechanism is that of a catalyst—any substance which influences the speed of a reaction and yet remains unchanged at its completion. Both copper and steel, the more common materials of construction in contact with the oil, are active catalysts, although the effect of copper is more pronounced.

Chemical instability manifests itself by the formation of organic acids, metallic soaps, and sludge. The changes effected in refining processes combined with the use of oxidation inhibitors have greatly improved oil stability and extended service life. In the author's seven years' experience with the new-type oils, there has been scarcely any indication of oil deterioration; however, several other companies have reported severe sludging, which developed without warning.

Rust Prevention

Rusting is caused by moisture in the oil. Complete prevention of this corrosion would seem to require either that the system be kept absolutely dry or that it be fabricated with materials not subject to corrosive attack, neither of which is considered at present to be practical. System designs are such that traces of moisture are always present and at least an occasional wetting of some consequence is seemingly inevitable. The cost of corrosion resistant materials has prevented their use to date,



OLD TYPE OILS	NEW TYPE OILS	
No Inhibitor Added	Oxidation Inhibitor Only	Oxidation and Corrosion Inhibitors
(d) Used oil, seven years' service—no corrosion	(a) New oil—severe corrosion (c) Used oil, seven years' service — severe corrosion (f) Used oil, five months' service — severe corrosion	(b) New oil—no corrosion (g) Used oil (f), one month after adding corrosion inhibitor—no corrosion (h) Used oil (f), three months after adding corrosion inhibitor — moderate corrosion. Corrosion inhibitor apparently depleted
(e) Used oil (d) 10% + New oil (a) 90%—No corrosion		

Fig. 2. Specimens from tests for rust-preventing characteristics of steam turbine oils (a, b, c, d, and e, by ASTM test D665-42-T; f, g, and h, by ASTM test D665-44-T)

but the idea is certainly not wholly inconceivable in the future.

Having accepted moisture as an unavoidable evil which must be lived with, two distinctly different measures for controlling its influence are now being tried, namely, painting of accessible internal surfaces and the use of corrosion inhibitors. The practice of adding old, rust-preventing oil to the new oil has not been favorably received. Appreciable amounts were sometimes required and, in any case, such treatment meant pollution of a highly refined oil.

Use of Paints Expanding

The currently expanding practice of internally painting the reservoir, bearing pedestals and housings is believed to be highly commendable, but the practice should also include the oil piping. Paints that can be used for this purpose are obviously limited, although several specific products are now commercially available. Of course, no paint should be employed that is not known to be suitable under the existing conditions with respect to adherence to the metal surfaces and solvent action by the oil.

Not much information is available on corrosion inhibitors and their use is still in the experimental stage. It is known that some inhibitors effectively prevent rusting; whether this corrosion protection continues for the life of the oil is uncertain. There is evidence that the inhibitors are preferentially water soluble and may be leached out in case of water contamination, consequently, the inhibited oil make-up additions may not be sufficient to maintain corrosion inhibition.

Laboratory tests indicate that some of the corrosion inhibitors passivate the metal and thus yield some protection even after the inhibitor is exhausted. However, the protective nature of the film is destroyed by continued wetting with a non-inhibited oil-water mixture. To insure protection at all times, the inhibitor content of the oil should exceed a specified minimum concentration. As inhibitor is consumed or leached out by water, more should be added. Additions could be based either on analytical determination of inhibitor content or on laboratory corrosion tests. The analytical method is obviously more desirable because inhibitor exhaustion could thus be anticipated. However, the reluctance of refiners to divulge the inhibitor composition or analytical methods for its determination forces the operator to rely on the corrosion test as a measure of inhibitor sufficiency.

Because of the meager information and varied experiences with corrosion inhibitors, extreme care should be exercised in their use. Satisfactory results have been obtained with one brand of corrosion-inhibited oil in the author's company, but in laboratory studies, anticipating the addition of a corrosion inhibitor to another brand with several years' service, the results were not so pleasing. The corrosion inhibitor specifically recommended and supplied by the oil refiner was found to make any contaminating water highly alkaline and to cause the formation of emulsions very comparable to mayonnaise. Further investigation revealed that a number of changes have been made in the inhibitors employed in recent years by one of the major oil companies. This condition emphasizes the uncertainty of the results with corrosion-inhibited oils and indicates the possible hazard of mixing two or more chemicals which may not be entirely compatible either with each other or with the oxidation inhibitor.

The Oil System

In spite of their pronounced influence, improved refining methods and the use of chemical additives supplement rather than supplant sound system planning and good operating practices. Because of the marked effect of temperature, the oil piping should be so arranged that there are no "hot spots"—areas where high temperature steam lines are in close proximity to those for oil. Consideration should be given also to system cleaning and drainage. Low pockets that cannot be drained or that might serve as traps for sludge and sediment should be avoided. In this connection, the use of small, readily cleanable filters in the governor and bearing supply lines is strongly recommended during normal operation.

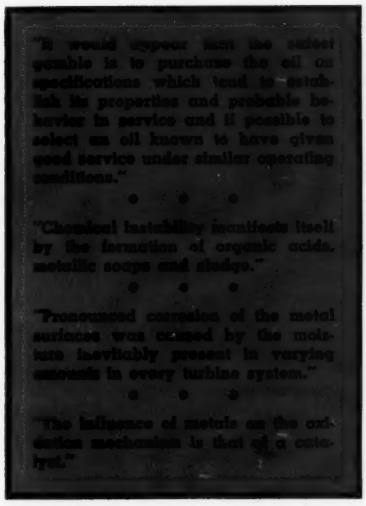
Cleanliness of System Important

Much depends, too, on the cleanliness of the system when the oil is first added. It is perhaps incongruous, but in manufacture and construction the various parts become polluted with about everything that should be entirely absent during operation. Mill scale, weld spatter, metal turnings, core sand, cutting oil, pipe cement and various surface-protecting compounds are invariably present and should be removed.

Effective removal of the solid contaminants requires mechanical changing. This should be supplemented by the circulation of a comparatively light petroleum fraction known either as flushing or wash oil. This latter treatment is believed to be desirable for old systems also, when making batch changes. Following the cleaning process, thorough inspection of all reservoirs, bearing pedestals, and as much piping as possible, is very important. Any sediment should be

completely removed and the accessible oil-wetted surfaces wiped with clean, dry rags, if necessary. It is particularly essential that every low spot be drained so that none of the light oil remains to contaminate the lubricant.

As a precautionary measure, it is good practice to filter all oil that is admitted to the system. Blotter



presses are used in the author's company for this purpose. They are also used effectively during the initial operating period of a new oil to remove suspended material that was not wholly removed by system cleaning procedures. In this respect they are often more effective than centrifuges; Steam Emulsion Numbers of oils in service have been lowered appreciably in a number of cases where centrifuging was ineffective.

Due consideration should also be given to bearing insulation where the turbine drives a generator or where other equipment capable of inducing stray currents, operates in close proximity to the turbine. Inadequate or faulty insulation may lead to serious electrolytic corrosion of bearings and journals.

Care of Turbine Oil in Service

Since at best the oil system provides an environment that is intrinsically destructive to oil, the creation and maintenance of conditions that are as clean and dry as other practical considerations will permit, remains the best insurance against lubrication difficulties. It is essential, therefore, that every system be equipped with some means for purifying the oil either continuously or as the occasion demands. Caution must be exercised, however, in choosing the methods of treatment, since some of them adversely affect the oil by removing both natural and added inhibitors.

The care of turbine oil in service requires constant vigilance on the part of the operating personnel. Their part in detecting the first signs of oil contamination and taking immediate corrective measures cannot be overemphasized. In the author's company, the operators have become conscious of the ever present possibilities of water contamination and sludging, and of their damaging influence. They make visual examinations daily of oil samples from each unit. After inspection, the samples are retained for re-examination 24 hr later, since small amounts of moisture are often not evident at the sampling temperature, but are revealed subsequently by the cloudiness which develops as the oil cools.

Procedure in Using Samples

Special racks for holding two one-half pint samples from each unit are provided as shown in Fig. 3. After initial examination, the sample is placed in the section marked "Today." The following day it is re-examined and placed in the section marked "Yesterday." Should the sample appear cloudy, the centrifuge is put in service immediately and an investigation is started to determine the source of the leakage, and a special sample is taken for laboratory study to ascertain the nature and the extent of contamination. Another simple but very practical indication of oil stability is the determination of the amount of sludge removed by the centrifuge equipment. The operators retain the sludge removed from the centrifuge bowl whenever it is cleaned, the weight being made a part of a running record, which indicates relative changes in the rate of oil oxidation.

To determine possible changes that are not apparent from visual examination, samples of the oil are analyzed monthly for Neutralization Number, Steam Emulsion Number, Precipitation Number, Water and Sediment, Viscosity and Color. These tests not only supplement the practical observations made in the plants, but also supply information indicative of potential oil deterioration at a rate which might necessitate either general reconditioning or complete replacement.

With the old-type oils, considerable reliance was placed on the Neutralization Number test alone as a measure of deterioration rate and in predicting possible service life; with the new-type oils this test does not appear to be as significant. Although the author has had no such experience several cases of severe sludging have been reported where only a slight rise in the Neutralization Number was noted. Presumably the oxidation inhibitor is slowly consumed and, after an extended service period, its concentration is so low as to be ineffective. If this is true, then the logical scientific corrective measure would be to maintain a definite concentration of the inhibitor in the oil by additions based on analytical determinations. The amount of make-up is undoubtedly an important factor from the standpoint of both inhibitor addition to and "sweetening" of the oil.

Because of the anomalous sludging experiences with the new-type oils, considerable attention has been focused on tests, other than the Neutralization Number, which might more accurately predict oil failure. To this end some investigators have utilized the Saponification Number test, but more recently the measurement of Interfacial Tension has gained wider acceptance. Within certain limits the magnitude of the Interfacial Tension appears to be of little significance, but for a particular oil, an abnormal decrease in film strength is reported to be indicative of incipient deterioration and sludging. Coordination of Interfacial Tension with other tests such as the Neutralization Number is also being studied in the evaluation of oil quality.

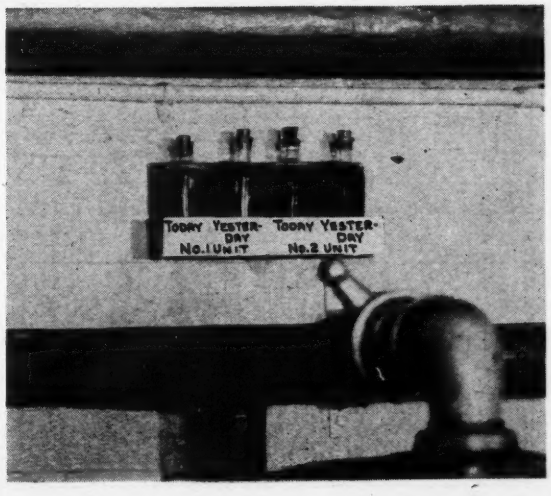


Fig. 3. Samples of turbine oil taken daily for visual examination by operators

Water Softening Time Shortened -

Success of the lime-soda ash process of water softening depends upon the thoroughness and rapidity with which precipitated particles are removed from treated water—Intermittent and continuous systems are being followed by the more rapid Accelator system —Principles of operation of the Accelator are described—The characteristics of slurry are treated and advantages of its recirculation pointed out—Concentrator element and its function described

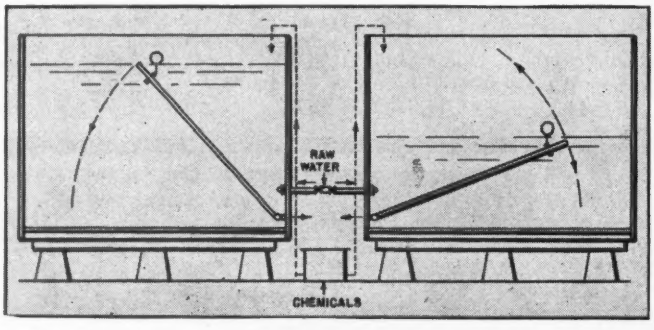
By **A. C. EMBSHOFF** *Manager, Industrial Division, Infilco, Inc.*

WHEN chemicals are dissolved in water they are, in effect, just tremendously subdivided so that the ions of which they are composed are dispersed or distributed through the water. In consequence, the particles of precipitate formed by reactions of the chemical ions with the ions present in the water as dissolved mineral matter are, at the instant of reaction, tremendous in number and extremely small in size.

Millions of ultra microscopic particles are, then, the first state of reaction or precipitation. This condition is sometimes described as colloidal but supersaturation seems a more appropriate description because of the tendency of the water softening precipitates to stay in solution in concentrations greater than their normal solubilities. These very small particles originally formed must and do grow by precipitation of newly formed and supersaturated material upon them, but they have a long way to go before they get large enough and heavy enough to settle out with any rapidity. Time is required to achieve this necessary growth, and this explains, largely, the inefficiency of the intermittent softener.

When the intermittent softener was converted to a softener of the continuous type, a number of factors tending to promote precipitate growth were introduced. The first was the continuous application of small amounts of the treating chemicals in proportion to water flow; the second was mechanical agitation which provided for thorough mixing with consequent improved utilization of chemicals and contact of the newly formed microscopic precipitate particles with each other; and the third was the slow but continuous, flow of water through the plant which provided further opportunities for precipitate contact and growth. With these added factors, growth of precipitate particles to sizes which would settle with reasonable rapidity was hastened with consequent increase in plant throughput. In other words a greater opportunity was afforded the newly formed precipitates to coalesce with, and to grow upon, other precipitates to form a more rapidly settling sludge.

Fig. 1. Simplified diagram of intermittent softener which provides for about 7 to 8 hr detention. Tanks were 26 ft in diameter



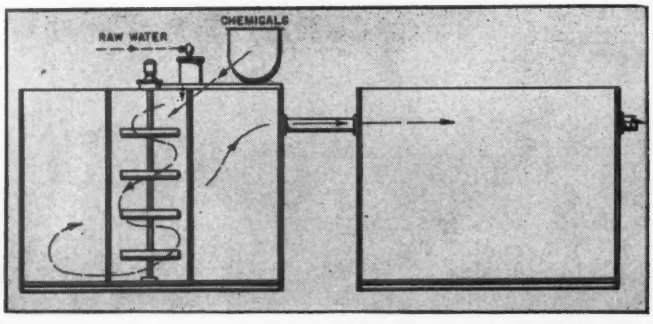


Fig. 2. Softener in Fig. 1 was converted to the continuous type by adding a downtake with a mechanical agitator and a pipe spider sludge pickup

Accelator Principles

Now comes the Accelator principle of operation, and with it most previous conceptions of what constitutes proper water softener design becomes obsolete.

The construction of Accelator mechanism is shown by the accompanying functional section drawing, Fig. 3. Water to be treated and treating chemicals enter the primary mixing chamber and are there subjected to a vortex circulation created by the motor driven impeller, and a portion of this mixture is simultaneously pumped into the secondary mixing chamber which comprises an inner and outer draft tube, from which it returns to the primary mixing chamber. The rate of circulation through these mixing chambers is three to four times the rated capacity of the softener.

As the unit starts in operation, the mixing and circulation it affords bring about rapid accretion of the first formed precipitates, causing them to grow to form the conditioned slurry on which the unit depends for accelerating water treatment reactions. Once this conditioned slurry is formed, the raw hard water meets chemically impregnated slurry. As a result, reaction products are precipitated on the surfaces of the slurry particles which are maintained in continuous circulation by the means described. Under these conditions, reaction of the water with its aliquot portion of treating chemicals does not result in the formation of millions of colloidal particles as in the earlier

types of water treating equipment, and the time factor required to permit growth of such particles to appreciable size is no longer necessary.

As a consequence, the slurry transferred through the secondary mixing zone into the secondary reaction zone is already well conditioned and, if it were permitted to do so, would settle very rapidly. Transfer of the slurry from the secondary reaction zone into the slurry pool takes place under the head created by the transfer impeller. This flow, as previously noted, is generally three or four times the volume represented by the flow of treated water through the unit at rated capacity and, as a consequence, there is a positive sweeping wash effect maintained which prevents deposition of solids on surfaces in the lower portion of the tank. In proportion to the raw water supplied, an equal portion of treated water is displaced from the slurry pool and rises to the clear water launders.

Slurry Characteristics

The character of the slurry is such that water separates from it at remarkable rates. It is not at all unusual to obtain clear water from the surface of this pool at rising rates of 3 or more gal per sq ft per min of free area. The capacity of the unit is limited only by the rate at which clear treated water may be withdrawn from the slurry pool and it should, by now, be quite clear that retention time has no place or value in setting the capacity of a unit of this type. Time need not be allowed for coagulation because precipitation has instead taken place on the slurry particles and once water is separated from the slurry pool, additional time is of no value.

This separation of clear water from the slurry pool is something quite different from the old "sedimentation" involved in previous practice. Whereas a gradient of solids concentration may exist in one of the old settling tanks or basins so that the concentration of solids at one level is considerably different from that at another level, the situation is quite different in this system. The water is literally squeezed out from the surface of the slurry pool because the masses resulting from the compounded precipitation are too heavy to be carried up the tank by the buoyancy of the rising clear water. For this reason, it is not at all unusual to stand on top of this unit in operation and look down through six or seven feet of clear water to see the billowing surface of the slurry pool which appears to be almost a white blanket from which clear water is continually emerging. The top surface of this pool is sharply defined and samples taken from the tank may show several per cent of solids at a level just below the surface of the slurry pool, whereas samples taken a few inches above will contain only a few parts per million of suspended solids.

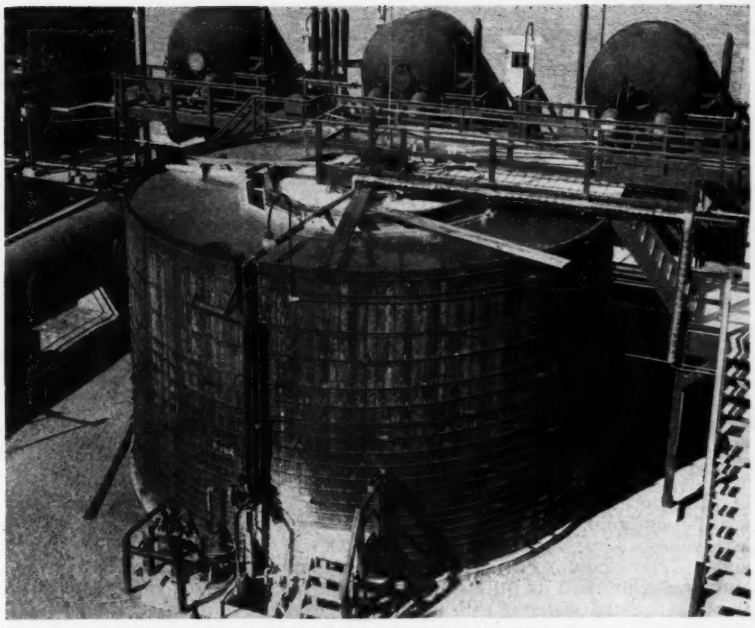


Fig. 4. Accelator of 1200 gpm capacity, 25 ft diameter, provides softened water for an oil refinery

To sum up the action of this slurry, it may be said that by adding the chemicals to the slurry and then mixing in the water there is produced such a condition of accelerated chemical and physical reaction that complete mixing is practically synonymous with full benefit of treatment. Soluble treating reagents are reacted immediately and the products of reaction removed from a state of supersaturation by the agitation with the tremendous surface of precipitation offered by the slurry. In accordance with the laws of mass action, this removal of colloidal material permits the reactions to proceed at faster rates and more nearly to completion.

These softeners need, then, but little space and can be fitted into existing plant facilities with a minimum of floor space and head room requirements. The savings obtainable by use of these efficient tanks can be quite impressive, especially when referred to the old criterion of retention time.

Recirculation of Solids

It is apparent from Fig. 3 that the retained solids are circulated over and over again, each time increasing

. . . To This

Fig. 3. Diagrammatic cross section of Accelator process of water softening

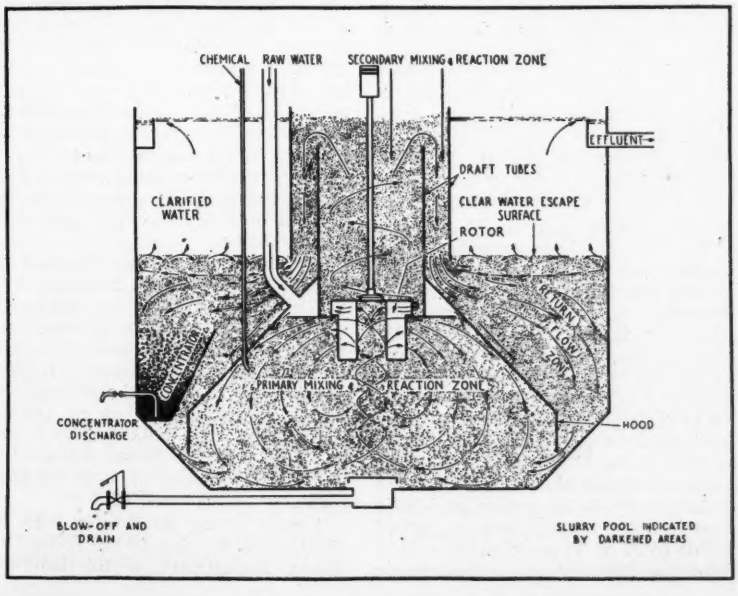


Fig. 5. A Southern paper mill is provided soft water by this Accelator installation. It has a capacity of 1500 gpm, is 32 ft in diameter

in mass and improving in condition until an optimum condition of slurry is attained. Lime not yet dissolved and still unreacted is circulated over and over again until its full value for treatment of the water is exhausted. This fact accounts for an efficiency in which the lime used closely approaches the theoretical and so considerable expense is saved in the course of a few years' operating time. The sludge removed from one of these softeners will show only a trace of unused chemical.

Shutting down the softener for varying periods of time is common practice; and it is quite satisfactory to use this type of operation, because the efficient circulation provided in the reaction zone very quickly resuspends the solids on resuming operation. The mixing and circulating

1. Accelerated physical and chemical reaction.

2. Accelators need little space, can be fitted into plant facilities.

3. Savings through reduction in retention time.

impeller is located above any settled sludge and being of moderate diameter there is no danger of overloading the drive motor or of shearing the drive shaft when resuming operations after a shutdown.

The accelator slurry generally contains between ½ and 2 per cent of solids by weight. The amount depends on the character of the water being treated and the extent of treatment. Calcium carbonate and magnesium hydrate are quite different in their physical characteristics and the physical character of the slurry formed in a softener will depend, among other things, upon the proportion of these materials precipitated under any given operating condition. Suffice it to say that a certain concentration of slurry characterizes each condition of operation and fixes the concentration of solids in circulation. When more than that quantity of solids necessary for proper treatment is precipitated, the excess simply expands into the portion of the tank immediately above the slurry pool and, when the level of this expanded slurry reaches the top of the concentrator, the excess solids flow over into the concentrator from which they may be removed as a rather heavy sludge.

Operating Principles of Concentrator

The concentrator is an important feature of this system. In simple terms, it is simply a chamber, usually within the tank, in which there is no circulation and through which there is no velocity or buoyant effect of rising treated water. As a result, the solids skimmed off over its edge settle into the concentrator; compact by reason of their tendency to settle; and, are drawn off at concentrations considerably greater than exist in the circulating slurry. The concentrator is usually integral with the unit construction and in no way interferes with the effective area from which clear water may separate. By means of the concentrator there is maintained a continuous removal of excess solids while still assuring an adequate supply of slurry for action. The concentrators require no extra tankage external to the unit and, consequently, no additional pumpage of water or sludge.

The fact has been mentioned previously that no sedimentation is permitted in this softener. A direct advantage arises from this fact. Consider for a moment that in an old type settling basin or clarifier, the solids are expected to settle and accumulate to the depth of several feet. As compared with this particular equipment in which, perhaps, 25 per cent of the total small volume of the tank contains a slurry of 2 per cent solids by weight, a conventional basin may contain several feet of settled solids of 20 or 30 per cent by weight. Whereas this unit may, then, retain the solids of only a few hours' operation, the conventional basin may have the solids of several days or even weeks of operation. Because of the continuous addition to and removal of solids from the unit the precipitated matter is in contact with treated water for a relatively short time and unpleasant tastes and odors from sludge putrefaction are much less likely to occur.

Control of Coke Density

VARIATIONS IN THE BULK density of coal used in byproduct coke ovens—a serious handicap to efficient oven operation and production of the uniform coke needed for blast furnaces—are reduced by the addition of small quantities of oil to the coal mixtures, according to a progress report released recently by the Bureau of Mines on its coke production survey.

Oil lowers the excessively high bulk density or weight per cubic foot of dry coal and increases the bulk density of wet coal, tests on samples of the mixtures used at three byproduct coke plants disclosed. Even the bulk-density fluctuation in a single oven charge is decreased by application of oil, the authors state. They warn, however, that care must be used in its application at plants using coal mixtures that tend to produce high expansion pressures, for increased bulk density may aggravate this condition.

The report which was prepared by W. S. Landers, L. D. Schmidt, and William Seymour, Bureau engineers stationed at Pittsburgh, Pa., describes testing methods and a new procedure for determining bulk density. Known as the "dropped coal method," it yields results which agree closely with the average bulk density found in actual practice. Some methods for handling and applying oil at the coke plant also are presented.

A copy of the publication may be obtained by writing to the Bureau of Mines, Department of the Interior.

District Heating and Electric Generation by Utility Companies

By Walter L. Bartel

THE war production effort has created in recent years many new manufacturers of both steam and Diesel engines. Many of these engine production operations are in the hands of aggressive, determined men supported by alert and progressive staffs of able engineers. These men, as reflected by their current advertising copy, seem to have reached the conclusion that there is a very extensive, economically sound market for their engines in supplying electric power for hotels, office buildings, large apartment houses and industrial plants.

This is not a new discovery but just a recognition of the sound possibilities for expansion of the isolated power generation that has persisted for many years in all large and many smaller cities.

Many people are prone to think of all light and power being supplied by central stations, but such is far from the actual situation. From any high office window in New York, Chicago, Pittsburgh, Minneapolis, or any other large city, an observer can always count numerous exhaust heads puffing steam from the roofs of surrounding buildings. These active exhaust heads are especially conspicuous in downtown Chicago, and each one marks an isolated power generating plant. The number when counted is an amazing total. Well directed, aggressive and determined engine sales effort in the post war period can be counted on to multiply the existing total. This expansion will occur both in single buildings and industries and in groups of buildings that are contiguous so that they can be served with steam and power without crossing public highways.

These isolated power plants are not just accidental oversights of the central power salesman. They continue to persist and to increase in spite of 35 years of the most skilled salesmanship that the power industry was able to exert. These isolated plants persist because of their inherent economic advantage, and for this same reason they can be expected to increase with the intense competitive conditions prevailing in the post war period.

The inherent economics of the isolated plant are well known. They consist of conditions which permit the economic use for necessary space and process heating of the seventy-five per cent of the heat of the steam, which in central plants is wasted to heat river or other water. This 75 per cent waste is just too much of a handicap to expect the central power service to overcome in those instances where the isolated plant can devote the engine exhaust to useful purposes.

The extent to which a given installation can by itself or by combining its operations with those of adjacent buildings profitably use the exhaust steam, determines the heat balance and the extent to which the isolated operation will be profitable as compared with the purchase of electric power. In general, exhaust to the roof from isolated power plants represents lack of heat balance and consequently comparatively expensive power, the cost of which must be and frequently does offset the low cost by-product power during the periods of heat balance.

The high cost of this unbalanced power is now frequently reduced in substantial amount by the use of a Diesel engine during periods when heat balance is lacking. This does not mean investment in duplicate plant as might first appear. All such plants have a reserve generating unit and such a unit when installed as a Diesel engine avoids duplication of plant. In such cases the Diesel unit is the reserve unit in the Winter and the steam engine is the reserve unit in the Summer when need for exhaust steam is at a minimum. Such a combination gives remarkably low operating costs.

There is no particular reason why the utilities should anticipate this post war period of intense engine competition with pessimism and fear. These same utilities sit in the very best position to profit handsomely from this definite and inevitable trend. These utilities have the engineering organization and the steam generating know-how. They know what it costs to generate high pressure steam and the distribution of the steam to the customers is just a grand underground extension of their generating station steam piping. Progress in the art has removed all the imponderables and grave difficulties from the problem of distributing high pressure or superheated steam. This ability to distribute high pressure steam at once establishes the economic security of the central steam utility and opens up a vast field for new and profitable revenue which was never profitable when steam had to be distributed at low pressures.

According to the author, the central station can, by selling steam in the winter and electric power in the summer, produce a flattened load curve, increase its market, protect its future revenue. Further, it can do a good public relations job by cleaning the atmosphere of smoke generated by the less-efficient plants.

Distribution at high pressures not only lowers the distribution investment cost, and the year around stand by losses per unit of delivery capacity, but it greatly expands the potential market by including as profitable customers all of these isolated power operations and other commercial and industrial process uses for steam at pressures above twenty-five pounds. These combined uses reach an enormous total and when consolidated result in a load factor comparable with the load factor on the central electrical system. The dollar volume will greatly exceed the dollar volume from electricity in the same area.

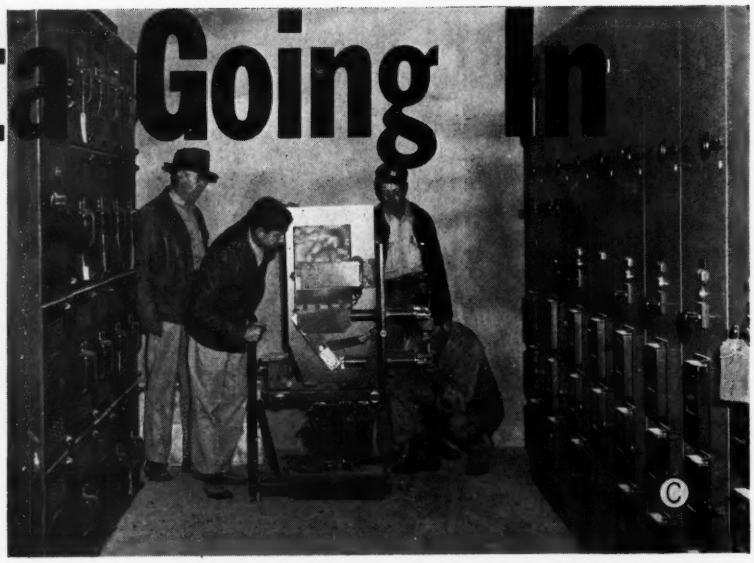
This steam utility service if promptly exploited and extended by the existing utilities holds high promise of still other profitable results. If this steam service is made available it will definitely influence the purchase of steam rather than Diesel engines. The purchase of a Diesel engine for Summer operation can then be avoided by smart adjustment of power rate schedules so as to invite the use of power from the central system during the Summer months when there is little or no use for the exhaust steam. This would result in a substantial reduction in the sharp seasonal Winter electrical peak loads and would fill up the deep seasonal Summer valleys in the load curve. Such a pronounced change in the annual load curve would greatly improve the annual load factor with resulting profits that always derive from such improvement.

The intelligent development of this joint utility operation will not only economically fortify the future of the utility, it will solve heating problems for the building owner, and, most important of all, it will clear up the

(Continued on page 116)

Sarasota Going In

Here are the "internals" of a modern central station while it's being tuned up—details you can't see after the insulation and casings and paint have been put on. Here, too, are the men of the construction and station operating crews in the act of installing and tuning up the equipment they're going to operate. The station is the new Sarasota Steam Electric Station of Florida Power & Light Co. at Sarasota, Florida. It forms an important link in a two-year expansion program into which the company is puting $24,000,000 to back up its belief in the future growth of Florida.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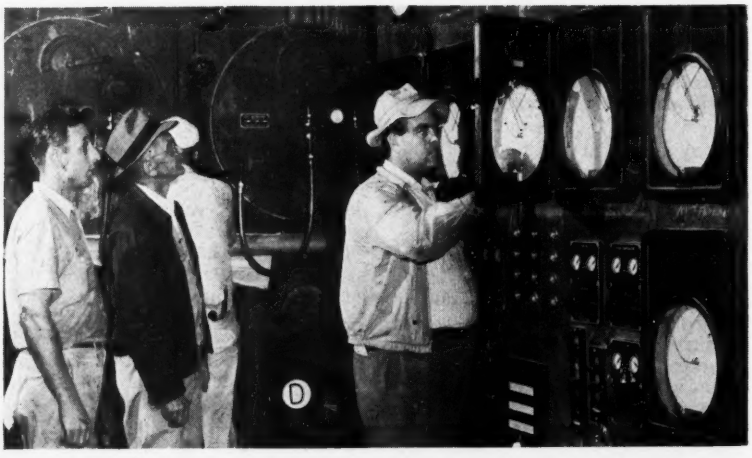
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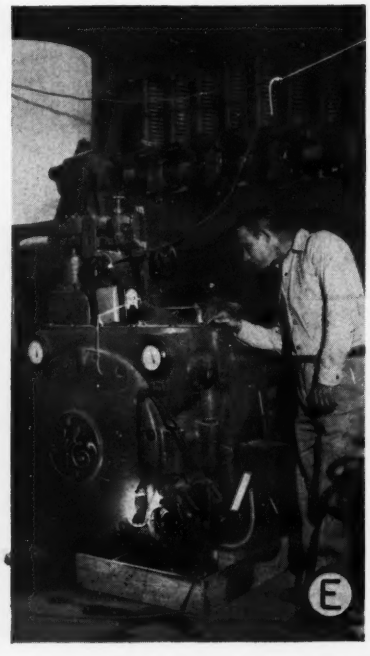
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F

A—Electrician W. C. Teagle completes a wiring job

B—Fireman H. W. Stelts makes an adjustment on the automatic boiler control panel as Fireman Harold Bunton changes a burner

C—C. G. Robbins, Walter Fush and C. O. Barnes inspect a breaker before it is installed

D—Harold Bunton, A. H. Hoff, J. Malhoit and E. C. Yaw adjust and check meters on automatic boiler control panel

E—Watch Engineer U. R. Gray reads turbine-generator speed indicator and other gages at head end of turbine

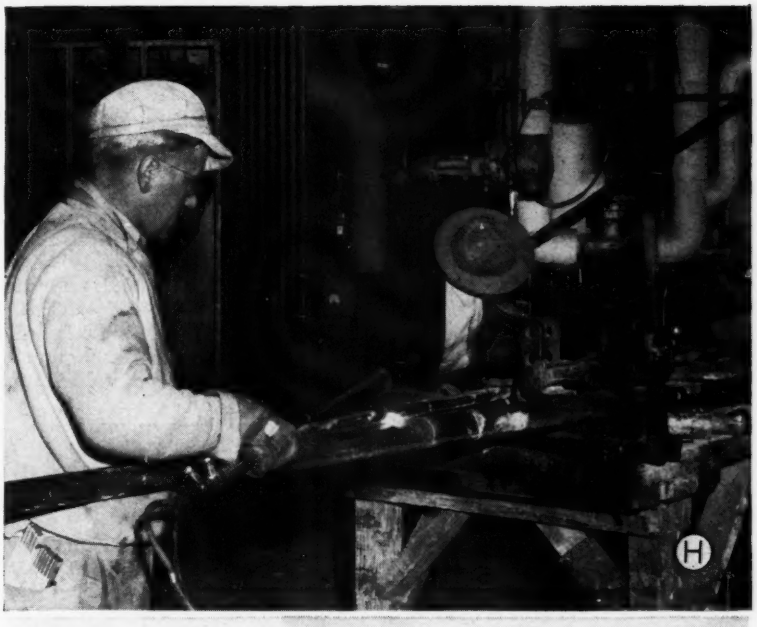
F—Watch Engineer W. W. Work and Assistant Superintendent R. T. Taylor check generator hydrogen cooling panel

G—Watch Engineer Jack W. Tubbs throws a switch that puts the new 18,000-kw unit on the line for the first time

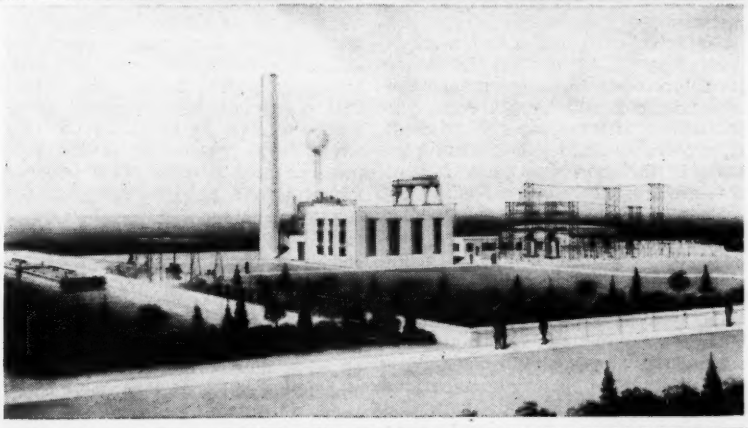
H—Walter Johnson and Leonard Leslie do some pipe fabricating

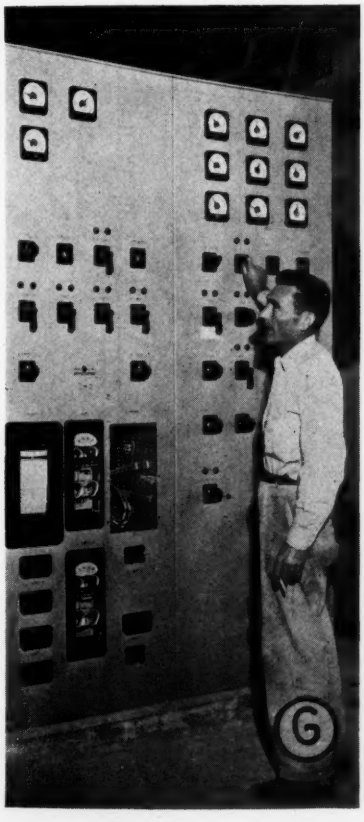
L—H. J. Gauggel, R. J. Henry and H. L. Holton put generator hydrogen cooling equipment into operation

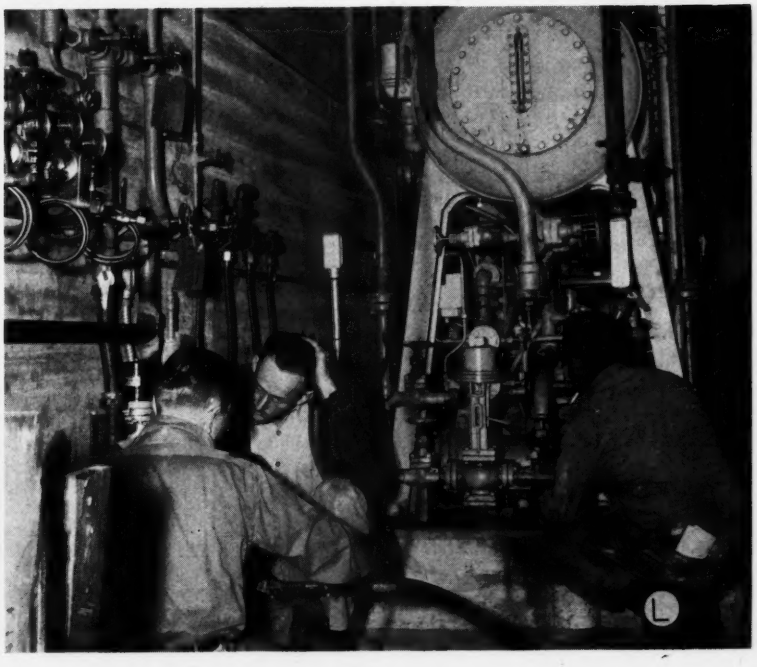
Right Center—Architect's sketch of Sarasota station



The Sarasota plant contains an initial installation of one 18,000-kw, 3600-rpm steam turbine-generator unit, to which steam at 920 psi, 900 F is supplied by a 200,000-lb-per-hr oil-fired steam generating unit. The electric generator is hydrogen cooled. The station was put into initial operation and delivered power to the transfission system on January 18, 1946. Elliott M. Brown is superintendent and R. T. Taylor is assistant superintendent.







How to Install Field Coils on Generators and Motors

Until one figures the centrifugal force acting upon a revolving field coil of a motor or generator one does not realize the importance of installing such coils properly. For example, the centrifugal force on a coil weighing 50 lb on machine operating at 1800 rpm is just about 50,000 lb—25 tons. This article presents information on the assembly and installation of such coils that has until now not been available outside the factory. Operators will find this information of value in making repairs.

By C. GENTILINI

Design Engineer, National Electric Coil Co., Columbus, Ohio

THE PROBLEM of properly constructing revolving field coils to safely withstand operating stresses has been satisfactorily solved, but the realization of satisfactory service life from the coils depends upon the adoption of several important details of procedure when installing them. The best field coil will have a relatively short life if it is improperly installed. It may be well to call attention to some of the more important factors that are frequently overlooked.

There are several types of revolving field coils—some wound on the pole piece and others wound on a form and subsequently transferred to a field pole piece. The conductors in field coils may be copper strap bent on edge or they may be round, square or rectangular copper wire insulated with various kinds of material selected to meet specific operating conditions. The following relates principally to field coils wound on a form for assembly on a pole piece.

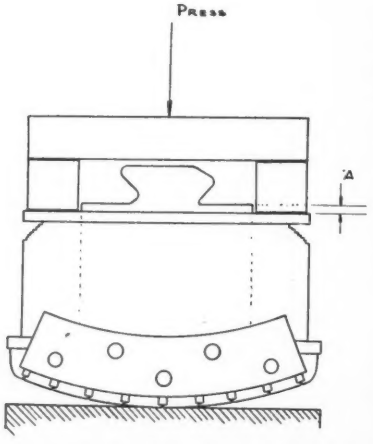


Fig. 1. Shop method using a hydraulic press for determining the thickness "A" of the insulating collars or shims required to fill the space "A" so that a tight coil fit is maintained when the coil in operation is subjected to centrifugal force

Two important factors in the mechanical assembling of revolving field coils are: a snug fit on the pole piece and a properly clamped fit between the pole lip and rotor rim or spider. A coil that fits loosely on its pole piece will chafe the insulation in operation and may vibrate to such an extent that the turns may separate, eventually leading to short circuits between turns, grounding to the pole piece or broken connections between adjacent coils.

The insulation around the body of the pole piece should be "built up" in thickness to completely fill the space between the pole piece body and the inside of the field coil. The material used and the thickness of the collar insulation around the top and bottom edges of the coil should be such that when the coil and pole piece have been subjected to centrifugal force, heat and age in service, no appreciable reduction in the height of the coil assembly will ensue.

The material for wedging the coil around the pole piece should be thin sheets of laminated bakelite or mica plate arranged to assure uniform surface contact (not line or point contacts), at the same time affording a material which is resistant to dimensional change by moisture, heat and age. The collars are usually made of laminated fabric base bakelite for the normal conditions but for extreme heat, moisture and compressive forces, laminated glass base material bonded with phenolics or melamine may be economically justified.

For low temperature, low moisture and low centrifugal forces, plywood or fibre may be substituted if the initial cost is a factor. It should be understood, however, that even under ideal conditions these latter materials will shrink to a certain degree and may allow the field coil to become loose.

The centrifugal force acting as compression on the field coil and collars may be calculated by the formula:

$$F_c = 0.00034\ WRN^2$$

in which F_c = Centrifugal force in pounds

W = Weight of the coil in pounds

R = Radius of rotation in feet

N = rpm.

As an example, assume that a coil weighs 50 lb and revolves at a speed of 1800-rpm on a radius of 10 in. (10/12 ft), the centrifugal force will be:

$$F_c = .00034 \times 50 \times 10/12 \times (1800)^2 = 45{,}900 \text{ lb.}$$

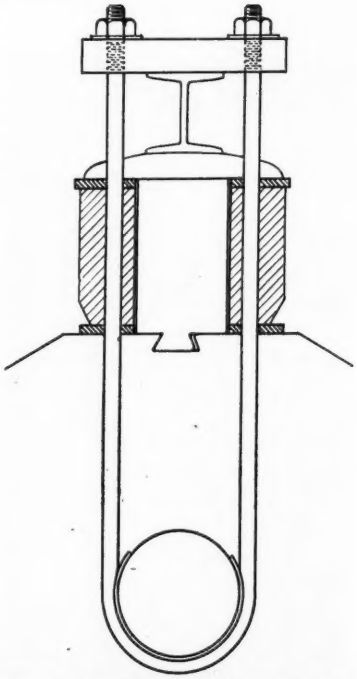


Fig. 2. Mechanical method used when a hydraulic press is not convenient to determine the thickness of insulating collars or shims required to maintain a tight coil fit when coil is subjected to centrifugal force. This device is also a means of holding the coil and pole piece assembly under compression while installing locking wedges or keys

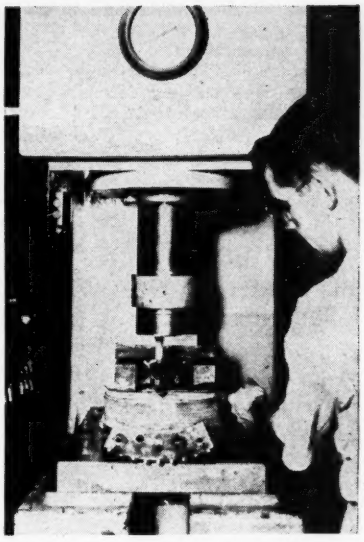


Fig. 3. A hydraulic press with a field coil and pole assembly in position for ascertaining the thickness of the required extra insulation needed as shown diagrammatically in Fig. 1

To maintain a tight coil fit under the high centrifugal operating forces, the coil and pole piece assemblies should be subjected to the calculated force F_c before locking them in place with wedges or keys.

This may be accomplished in either of two ways or by a combination of both. If a hydraulic press is available, the assembled coil with its insulating collars and pole piece is placed in the press and the required force F_c is exerted as shown in Fig. 1. The distance "A" between the bottom collar and the bottom of the pole piece is then measured with a depth gauge and insulation equal to this measured amount is placed between the bottom collar and spider or rim. The wedges or keys locking the pole piece to the spider must then be driven in tight enough to again subject the coil and collar assembly to the same amount of compression as the centrifugal force F_c which was used to determine the correct collar or shim thickness. This is of course necessary to draw the pole piece bottom tight against the spider or rim.

In order to facilitate compressing the coil and pole assembly, it is preferable to use a mechanical clamp as shown in Fig. 2 to hold the coil and insulation under compression while installing the locking wedges or keys.

The mechanical clamping device shown in Fig. 2 can also be used on large field jobs on location or where hydraulic press is not practical, for determining the necessary thickness "A", Fig. 5, for the insulating collars or shims.

Another important precaution is the centering of the pole piece on the spider. This may be accomplished by definitely locating a center-line on the rotor as well as on each field pole, and then proceed to set each field pole with its center line coinciding with the center line of the rotor. In some cases it may be necessary to resort to the use of a reference point on the shaft as a guide.

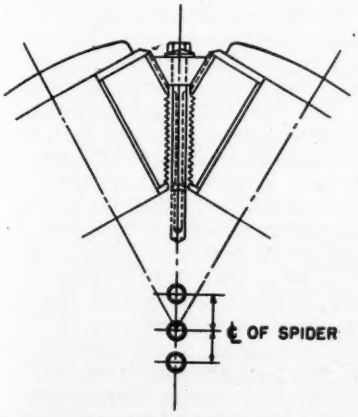


Fig. 4. Typical clamping construction to prevent bulging in the center of coils subjected to excessive centrifugal forces

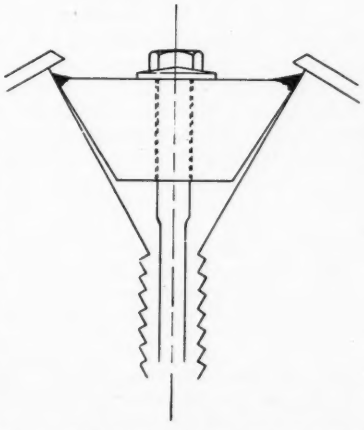


Fig. 5. This is how *not* to fit wedge blocks between coils. The wedge block must bear uniformly on the contact plates to be effective. Hand fitting is sometimes necessary to prevent a condition as shown

When all the poles with field coils have been assembled on the rotor, the connections between the poles are made and soldered. The field winding leads are then anchored to the rotor and connected to the collector rings.

If the centrifugal forces should be of greater magnitude, clamping blocks must be provided to prevent bulging in the center of the coil. Only strong material like laminated fabric base bakelite, aluminum, etc., having dimensional stability, should be used for this purpose. A typical clamping brace is shown in Fig. 4 consisting of a beveled block, laminated fabric base bakelite sliding plate between the block and the coil, insulated bolt and lockplates, etc. It is important to bevel the block to the proper angle to bear uniformly on the contact plates. Hand fitting of blocks is sometimes necessary to prevent a condition as shown in Fig. 5.

In addition to the several factors discussed above, it is of course basic that the polarities be correct, good soldered connections be provided, damper winding and collector rings be in first class order, the proper finishing varnish seal be used, and the completed rotor be dynamically balanced and subjected to the usual rigid electrical and mechanical tests.

By closely heeding the foregoing suggestions when assembling field coils on the rotor of electrical apparatus, long service life will be assured.

German Power Plant Practice During War

WARTIME ADVANCES by the German power industry, though limited, include several innovations in technical operation and construction of potential interest to American industry, according to a 421- page report released today by the Office of the Publication Board, Department of Commerce.

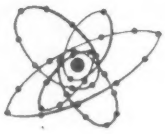
The investigators learned that BEWAG, Berlin's principal electric system, operated without a major breakdown from 1927 to 1944, and maintained an adequate power supply even during the last year of the war. This system, they believe, was among the world's best, for three reasons: inter-connection of nine central stations in Berlin itself and many powerhouses of other companies outside Berlin; development of a three-voltage group system; and excellent personnel organization.

Among the wartime innovations mentioned in the report is the use at the Bohlen plant of "channel" type superheaters, added ahead of the main superheater section in some of the boilers, to overcome slagging difficulties.

At the Espenhain plant, feeders for the industrial part of the plant were switched to an indoor 6000-v bus connected with the generator through long open bar leads. The bus was of open construction and made of magnesium.

A Schmidt-Hartmann type boiler served as a double evaporation unit at the Bitterfeld plant. The saturated steam generated in the boiler tubes was collected in an upper drum. From there it passed through a heat exchanger drum, where the second cycle steam was generated and passed to the superheaters and turbines. Steam from the primary boiler generation was condensed in the heat exchanger drum, and the condensate was returned to the primary boiler system.

In general, the Germans showed a tendency to obtain turbine power and supply process steam through steam transformers. In this way they obtained steam transformer condensate or drips for the high-pressure feedwater system.



ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

INTERNATIONAL CONTROL OF ATOMIC ENERGY

Consideration of a plan for the international control of atomic energy based on a report by the Secretary of State's Committee on Atomic Energy. This plan calls for the establishment of an international atomic development authority which would have the sole and absolute control of the World's supplies of uranium and thorium and also the sole right to develop and operate atomic energy plants regardless of their purpose. Only in the reaction of the very light nuclei and in the very heaviest has there ever been any large scale release of atomic energy

FAR MORE IMPORTANT at this time than the development of methods of utilizing atomic energy for peacetime purposes are the steps we must take to work out a plan for the international control of atomic energy. Unless such plans for its international control are worked out quickly there can be no assurance that this newly found force will not result in the total destruction of our civilized world.

It is clear at the present time that the atomic bomb or other weapon based on the use of atomic energy is a weapon in the employment of which no single nation can have a monopoly. True, this view has been disputed. Strong arguments have been brought forth, that the mass of technical and scientific knowledge and experience needed for the successful development of atomic weapons is so great that the results attained in the United States cannot be paralleled by independent work in other nations. Strong arguments have also been put forward that the degree of technical and industrial advancements required for the actual realization of atomic weapons could hardly be found in other parts of the world.

These arguments, however, have been met with great and widespread skepticism. It is recognized that the basic science on which the release of atomic energy rests is essentially a world-wide science, and that the principal findings required for the success of the bomb are well known to scientists throughout the world. It is recognized that the industry required and the technology developed for the realization of atomic weapons are the same industry and the same technology which play so essential a part in man's almost universal striving to improve his standard of living and his control of nature. It is further recognized that atomic energy plays so vital a part in contributing to the military power, to the possible economic welfare, and no doubt to the security of a nation, that the incentive to

This is the first of two articles dealing with the Report on the International Control of Atomic energy to the Secretary of State of the United States by the Secretary's Committee on Atomic Energy. This report should be read by every intelligent citizen because it presents perhaps the only possible workable plan for the control of this great new force. If atomic energy is not to destroy civilization it must be brought under control and the only way that it can be brought under such control is by an international atomic energy authority such as is proposed in this report. No single nation or even a small group of nations can ever hope to obtain or hold a monopoly on the use of atomic energy. Most intelligent people seem to realize this but until this report to the Secretary of State was prepared no concrete plan had been formulated whereby the danger of setting up such monopolies could be avoided. The Secretary's report provides a plan which would place the whole development of atomic energy for any purpose, whatever, whether for war or peace, in the hands of an international authority. It is a well thought out plan and it deserves the attention and consideration of every citizen whether he be an engineer or not. This first article considers the broad aspects of the plan. In a subsequent article will be presented a discussion of what the Report considers "Safe" and "Dangerous Activities."

[1] A Report on the International Control of Atomic Energy. Supt. of Doc. U. S. Govt. Printing Office, Washington 25, D. C. Price 20 cents.

other nations to press their own developments is overwhelming.

The atomic bomb appeared at the very end of hostilities at a time when men's thoughts were naturally turning to devising methods for the prevention of war. The atomic bomb made it clear that the plans which had been laid down at San Francisco for the United Nations Organization would have to be supplemented by a specific control of an instrument of war so terrible that its uncontrolled development would not only intensify the ferocity of warfare, but might directly contribute to the outbreak of war.

It is clear, too, that in the solution of this relatively concrete and most urgent problem of protecting mankind from the evils of atomic warfare, there has been created an opportunity for a collaborative approach to a problem which would contribute immeasurably to the prevention of war and to the strengthening of the United Nations Organization.

It was for the purpose of studying this whole question and formulating definite ideas regarding its ultimate solution that the Secretary of State early this year, appointed a committee to consider the problem in detail. This committee was composed of Dean Acheson, Chairman; Vannevar Bush, James B. Conant, Major General Leslie R. Groves, and John J. McCloy.

This committee later appointed a Board of Consultants composed of men of recognized attainments and varied background who could devote the major part of their time to detailed study of all factors relating to the problem. Since the date of appointment, January 23, 1946, this Board of Consultants spent virtually its entire time in an intensive study, visiting the plants and installations at Oak Ridge, Tenn., and Los Alamos, New Mexico, and days with numerous scientists, industrial experts, geologists and authorities in the technical fields concerned with atomic energy. On the basis of this study a comprehensive report was presented to the Committee which, later on, formed the pattern of the final report submitted to Secretary of State James F. Byrnes on March 17 of this year.

Substance of the Report to the Secretary of State

In a brief discussion such as this it is not possible, nor even desirable to present the complete report submitted by the Committee. Those specifically interested in the report can obtain it from the Superintendent of Documents.[1] Here, we shall consider only certain features of the report which are of interest to technically trained men and who are primarily interested in the use of atomic energy for peacetime purposes.

It is desirable, however, to know something about the nature of the report as a whole and this can be indicated by a general description of each of the four sections comprising the report. The plan of the report follows the following pattern.

Section I. An examination of the reasons leading to a commitment for the international control of atomic energy and the early proposal for realizing this objective by a system of inspection.

Section II. The essential characteristics of a workable plan for security together with the considerations that favor the development of a plan.

Section III. The essentials of an organization that puts the principles outlined in Section II into effect.

Section IV. Problems in the transition period leading from the present to the full operation of the plan.

In general, the report is submitted not as a final plan but as a place to begin, a foundation on which to build.

With respect to safeguarding the control of atomic energy by a system of inspection, the committee concludes that a system of inspection superimposed on an otherwise uncontrolled exploitation of atomic energy by national governments will not be an adequate safeguard.

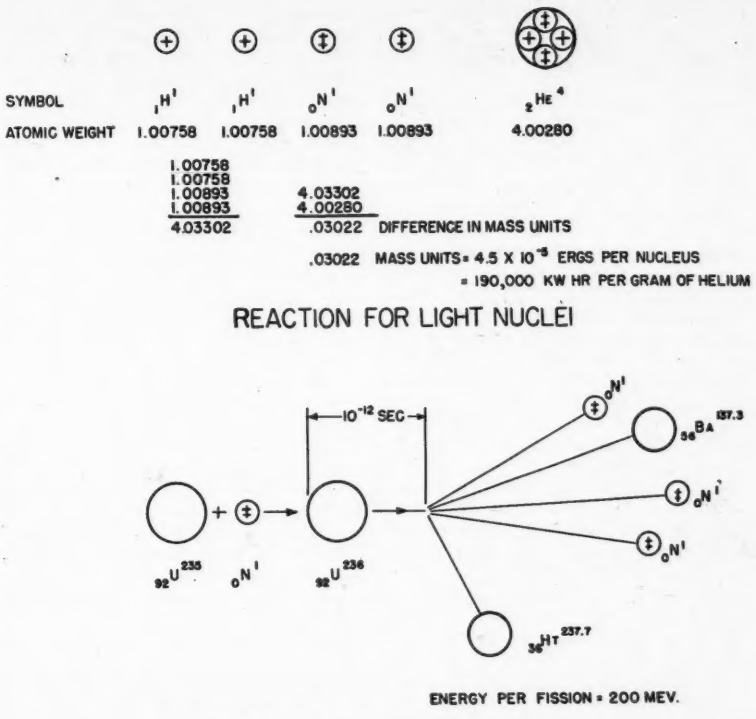
What Is Atomic Energy?

Those who have read the preceding articles published in this Section on Atomics since September, 1945, need not be told what atomic energy is but it is of interest to state here what the Report says about it.

Atomic energy according to the report refers to the energy that results from rearrangements in the structure of atomic nuclei of the elements. There are very strong forces which hold such nuclei together and account for their stability. The nature of these forces is not adequately understood, but enough is known about their behavior, not only to make it certain that the energy of an atomic bomb or an atomic power plant comes from the work done by these forces when the structure of the atomic nuclei is rearranged, but also to explain one major fact of decisive importance: Only in reactions of very light nuclei, and in the reactions of the very heaviest, has there ever been any large-scale release of atomic energy.

Concerning Light Nuclei

The forces which hold all nuclear particles together are attractive. When lighter nuclei combine to make heavier ones, and in particular when the lightest nucleus of all, that of hydrogen, is combined with another light nucleus, these attractive forces release energy. This combination of light elements to form somewhat heavier ones occurs in the sun and in the stars; in the sun effectively what happens is that four nuclei of hydrogen combine to form the more stable nucleus of helium. In the process, two of the protons are transformed into



Energy relations in nuclear reactions for light and heavy nuclei

ATOMICS

neutrons by the emission on an electron. Thus, what really happens is that two protons and two neutrons combine to form a helium nucleus, as shown in the accompanying illustration. Almost all sources of the energy used on earth come to us from the sunlight which this great atomic energy plant provides. But the conditions which make this plant possible are very special, and we do not know how to duplicate them on earth; we may very well never learn to do so. They depend on maintaining matter deep in the interior of the sun at very high temperatures—many millions of degrees. The nuclear reactions themselves provide the energy necessary to keep the matter hot; and it is kept from expanding and cooling by the enormous gravitational forces of attraction which hold the sun together and provide a sort of container in which this temperature and pressure can be maintained. For the foreseeable future the maintenance of such relations on earth will not be possible; in the immediate future it is certainly not possible.

Concerning Heavy Nuclei

Although nuclear reactions can be carried out in the laboratory for all nuclei, and although in some cases a given nuclear reaction may release energy even for nuclei of intermediate weight, the properties which make the large-scale release of such energy possible are peculiar to the very light nuclei and to the very heaviest. And the very heaviest nuclei have a property shared by more of the other elements. These very heavy nuclei generate energy if they can be caused to split into lighter ones; this unique property is called "fission." Perhaps a dozen nuclear species are known which can be made to undergo fission; under more drastic treatment no doubt the list will be extended.

To make atomic energy, however, takes more than the property of fission. The fission process itself must maintain itself or grow in intensity so that once it is started in a few nuclei a chain of reactions will be set up and a large part of the material will become potentially reacting. The agency which initiates this process is the neutron. In fission neutrons are emitted; and in certain nuclei bombardment by neutrons is enough to cause fission. There are several substances for which this is true, but there is only one substance which occurs in nature with any significant abundance for which it is true—that substance is uranium. Uranium is the only natural substance that can maintain a chain reaction. It is the key to all foreseeable applications of atomic energy.

One may ask why there are so few materials which undergo fission, and why so few of these can maintain a chain reaction. The reason lies in the fact that only the heaviest nuclei are sufficiently highly charged to come apart easily, and that only the most highly charged of all are sufficiently susceptible to fission on neutron bombardment to maintain a chain reaction. It is not to be anticipated that this situation will be invalidated by further scientific discovery.

What About Thorium?

A word needs to be said about the role of thorium, which is slightly more abundant than uranium, and for which fission is also not too difficult to induce. Thorium cannot maintain a chain reaction, either itself or in combination with any other natural material than uranium. Nevertheless, it occupies an important position with regard to safeguards. The reason for this can be stated as follows: Without uranium, chain reactions are impossible, but with a fairly substantial amount of uranium to begin with and suitably large quantities of thorium a chain reaction can be established to manufacture material which is an atomic explosive and which can also be used for the maintenance of other chain reactions.

Absolute control of uranium would, therefore, mean adequate safeguarding raw materials. Yet, since any substantial leakage of uranium through the system of controls would make possible the exploitation of thorium to produce dangerous amounts of atomic explosive, provisions governing thorium should be incorporated in the system to compensate for possible margins of error in the control of uranium. The coexistence of uranium and thorium in some natural deposits makes this technically attractive.

Factors Necessary for the Success of a Scheme of Control

There can be little hope of devising a successful scheme of control unless the problems can somehow be limited to the immediate future, by arrangements that have a reasonable prospect of validity for the next decade or two, and which contains sufficient flexibility to accommodate themselves to the inevitably changing conditions. It seems that a system of control which disregards all materials except uranium and thorium satisfied these conditions. Indeed if a successful system of control can be commenced now, based upon these materials, and if the time should ever come when other materials lend themselves to the same activities, it should be easier to include them within the system than it will be to set up the initial control system now confronting the world.

The fact that uranium and thorium are the only materials useful for the production of atomic energy make them of great strategic importance to nations seeking to establish for themselves a powerful position in the field of atomic energy. The fact that rich sources of such materials occur in relatively few places in the world, as compared for example with oil, creates a competitive situation which might easily produce intolerable tensions in international relations.

What is true in respect to the dangers from national competition for uranium is similarly true concerning other phases of the development of atomic energy. Take the case of a controlled reactor, a power pile, producing plutonium. Assume an international agreement barring the use of plutonium in a bomb, but permitting the pile for heat or power. No system of inspection could afford any reasonable security against the diversion of such materials to the purposes of war. If nations may engage in this dangerous field, and only national good faith and international policing stand in the way, the very existence of the prohibition against the use of such piles to produce fissionable material for bombs would tend to stimulate and encourage serreptitious evasion.

It is clear that if the element of rivalry between nations were removed by assignment of the intrinsically dangerous phases of the development of atomic energy to an international organization responsible to all peoples, a reliable prospect would be afforded for a system of security. For it is the element of rivalry and the impossibility of policing the resulting competition through inspection alone that makes inspection unworkable as a sole means of control. With the factor of international rivalry removed, the problem becomes both hopeful and manageable.

It is essential then that a workable system of safeguards remove from individual nations or their citizens the legal right to engage in certain well defined activities in respect to atomic energy generally agreed to be intrinsically dangerous because they are or could be made steps in the production of atomic bombs.

The force of the conclusions can be illustrated by a few simple cases. (a) Take the case of uranium ores. If any nation may engage in prospecting for and mining uranium ore, subject to inspection as to the proper, i.e., peaceful use thereof, inspection is a most difficult thing. But if the **only legal ownership and development of uranium ore** is in the hands of an international agency manned by and representing all nations, the problem of detection of evasion is by a single stroke, reduced tremendously. Indeed, by such an arrangement it is reduced to quite manageable proportions in the light of existing knowledge about uranium ore deposits through the world. For then it would be true that not the purpose of those who mine or possess uranium ore but the **mere fact of their mining or possessing it becomes illegal,** and national violation is an unambiguous danger signal of warlike purposes. The very opening of a mine by anyone other than the international agency is a "red light"

without more; it is not necessary to wait for evidence that the **product** of the mine is going to be misused.

(b) Take another illustration involving the building and operation in material that can be used for atomic weapons. The product is also useful for power piles. If all such piles are designed and operated exclusively by an international agency, then the building or operation of such a pile or any move in that direction by **anyone else** is illegal without respect to the use he says he plans to make of it, and constitutes a plain and simple danger signal calling for action of a preventative character by an international agency. Nor could there be a clearer sign of danger calling for immediate international action than interference with the operation of an international plant.

Other considerations are involved in the creation of an international atomic development authority. It will be necessary that any international agency seeking to safeguard the security of the world against warlike uses of atomic energy be in the very forefront of technical competence in the field. If the international agency is simply a policy activity for only negative and repressive functions, inevitably and within a very short period of time the enforcement agency **will not know enough** to be able to recognize new elements of danger, new possibilities of evasion, or the beginnings of a course of development having dangerous and warlike ends in view.

At present, the separation plants for U-235 at Oak Ridge are huge and bulky in the extreme, and use enormous amounts of power. Quite probably this will always be true. But it is not a law of nature. Those in whose hands lies the prevention of atomic warfare must be the first to know and to exploit technical advances in the field.

Here then, is an additional reason, and a very practical one, why a responsibility for the development of atomic energy should be vested in the same international agency that also has responsibility for developing and enforcing safeguards against atomic energy. For unless the international agency was engaged in the development activities itself (as in the design and operation of power piles or in the surveying and exploration of new sources of material) its personnel would not have the power of knowledge or the sensitivity to new developments that would make it a competent and useful protection to the people of the world.

In conclusion, it is clear (a) that only if the dangerous aspects of atomic energy are taken out of national hands and placed in international hands is there any reasonable prospect of devising safeguards against the use of atomic energy for bombs, and (b) only if the international agency was engaged in development and operation could it possibly discharge adequately its functions as a safeguarder of the worlds future. Such a development function also seems essential in terms of attracting to the international agency the kind of scientists and technicians that this problem requires.

Fire Resistance of Plank Floors

RECENT TESTS at the National Bureau of Standards, Department of Commerce, demonstrated the ability of heavy timber or "mill" construction floors to withstand fire.

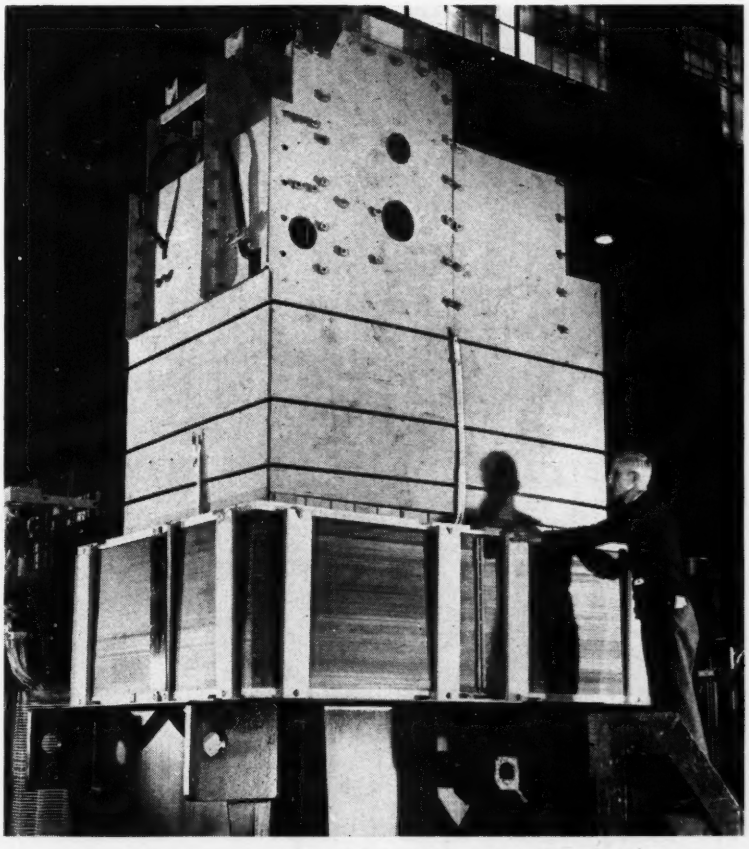
The limit of fire resistance of such floors, with the lower face exposed to fire, is determined either by failure under the normally carried working loads or by occurrence of flame or ignition of combustible materials on the upper side. The tests were made primarily to obtain information for use in connection with modern building codes. The lumber industry was actively interested in the test project.

It was already well known that this type of floor withstands fires better than lighter unprotected wood construction. The tests were made to determine how the heavy timber floor would behave when subjected to fires of the severity encountered in a standard furnace test.

In accordance with standard fire test requirements, the temperature in the furnace was raised to 1700 F within the first hour.

With a 1-in. finish floor on top, the fire resistance of laminated floors of 4-in. planks on the edge averaged 45 min, with 6-in. planks a little over 1 hr and with 8-in. planks about 1½ hr. With the structural portion of the floor of tongued and grooved plank of 3-in. nominal thickness laid flatwise, the fire resistance was near 45 min.

Impregnation of the wood with fire-retarding chemicals increased the fire resistance of 4-in. floors about 15 min. A comparable increase was obtained with a heavy coating of fire-retarding compound on the lower surface.



Transformer to Handle Mightiest Current

THREE SINGLE-PHASE transformers like this one are destined to handle the highest electric power voltage yet thrown on any transmission line. Standing 37 ft high when completed, the transformers will step up current to as much as half million volts for the American Gas & Electric Service Corporation's new high voltage test lines to be constructed near Brilliant, Ohio

5 Reasons for the Employment of Under-Bunker Conveyors....

By A. V. Stock

President
Stock Engineering Co.

Typical designs and installations . . . Automatic control equipment to insure proper feeding . . . Nineteen fundamental requirements for good design of under-bunker conveyors . . . Higher installation standards are needed

REQUIREMENTS of under-bunker conveyors are so different from the requirements of conveyors used elsewhere that we believe this specialized name for this type of conveyor helps to bring together knowledge regarding design and operation and thus assure better results.

Five basic reasons for the employment of under-bunker conveyors may be enumerated as follows:

1. To feed coal to stokers or pulverizers which are so located in relation to the bunker outlets that coal cannot be fed to them by gravity. An illustration of this necessity for an under-bunker conveyor would be a boiler house equipped with a silo or bunker* which is located at one end of a row of boilers. The conveyor carries coal from the silo or bunker down the line of boilers. A conveyor used for such an arrangement must be absolutely reliable since the plant cannot operate without it. It is usually desirable for plants of this design to have two conveyors in order to insure against failure of either one.

A modification of this plant arrangement is one in which the silos or bunkers are located in front of the boiler with one silo to one, two, or three boilers. A separate conveyor is generally used to convey the coal to each point of use. Reliability of conveyor operation here is also important, but not as important as in the plant arrangement previously mentioned, since each conveyor feeds only a portion of the line of boilers.

2. To reclaim coal from the "dead spots" which exist between the principal bunker outlets. These "dead spots" are usually largest in that portion of a continuous bunker which is between the boilers. The coal in the "dead spots" of a long bunker often can only be made available for use by the installation of an under-bunker conveyor.

3. To reduce the frequency of coal loading operations. Small bunkers necessitate an arrangement which will allow any coal not needed by one boiler to be made available to the other boilers, in order that the intervals between the loading of coal into the bunker may be as long as possible.

The modern trend of installing one or two high capacity boilers in an old boiler house in conjunction with old existing boilers often creates a need for an under-bunker conveyor. Since the new high capacity units carry most of the load of the plant and are on the line most of the time, they must obtain their added coal requirements by means of a conveyor from that part of the bunker in front of the smaller boilers.

4. To quickly and easily empty any section of the bunker for repairs or the prevention of bunker fires. Certain types of coal which are very subject to spontaneous combustion require some means of removing the coal from the bunker when the boiler is shut down. Sometimes, these shutdowns are not scheduled, and if no means are provided to empty the bunkers, a bunker fire can easily result.

5. To make possible the operation of the boiler plant for the maximum number of hours in the event of a breakdown of the equipment which elevates and conveys coal to the bunker. A conveyor makes practically all of the coal in the bunker available to all the boilers in service. It is, of course, possible to move coal within the bunker by hand, but this requires manual labor, which in the event of a breakdown will probably be difficult to obtain.

Typical Designs

Under-bunker conveyors must be designed to suit the individual requirements of every plant. There are, however, several more or less typical designs which fit the requirements of many plants. These are illustrated in Fig. 1 to 5.

Figure 1 shows an arrangement by which coal is received from a bunker

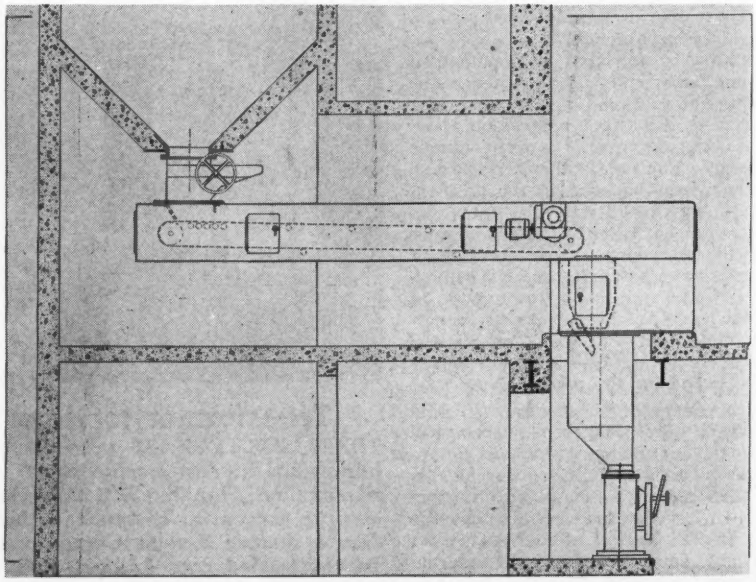


Fig. 1. Automatic coal scale with single elongated feed belt used as a conveyor. Bunker outlet is not more than 20 ft from a single point of use

This paper was presented at the Midwest Power Conference.

*See Power Plant Engineering, May, 1946 "Bins, Bunkers & Silos", by W. G. Hudson.

outlet not more than 20 ft horizontally from a single point of use. The coal scale illustrated is equipped with an elongated feed belt which acts both as a conveyor to transport the coal from the bunker outlet to the point of use and as a coal scale feeder.

The scale feed belt is started and stopped by the scale control, which thus keeps the hopper beneath the scale full of coal at all times. Installations of this type usually achieve reliability by the provision of duplicate feeding equipment.

It is often necessary to reclaim coal from a long continuous bunker parallel to a line of boilers and make coal in front of one boiler available to any of the other boilers. The solution to such a problem is illustrated in Fig. 2. This layout shows a typical "bunker to stoker" arrangement, with the exception of the coal valve which instead of being a single valve is in reality three valves and a short section of conveyor, all built in one housing. In the end elevation shown on Fig. 2, the left-hand portion of the triple valve, when opened, allows the coal to flow by gravity in a straight vertical line from the bunker outlet to the coal scale inlet. This is the normal method of feeding coal to the scale.

However, when it is desired to transport coal from this bunker outlet to another boiler, the top right-hand portion of the triple valve is opened, allowing coal to flow in a straight vertical line from the bunker outlet down onto the coveyor chain. This conveyor is a typical, dust-tight, drag flight unit. Coal is conveyed by the chain from the point under the open valve to the takeup end, where it falls from the upper chain to the lower chain. The lower chain moves the coal toward the conveyor head sprocket and discharges it at any point or any number of points where the discharge valves have been opened. The discharge valve is shown in the

Fig. 3. Photograph of typical bunker-to-stoker arrangement with triple valve similar to that in Fig. 2 and under-bunker conveyor without coal scales

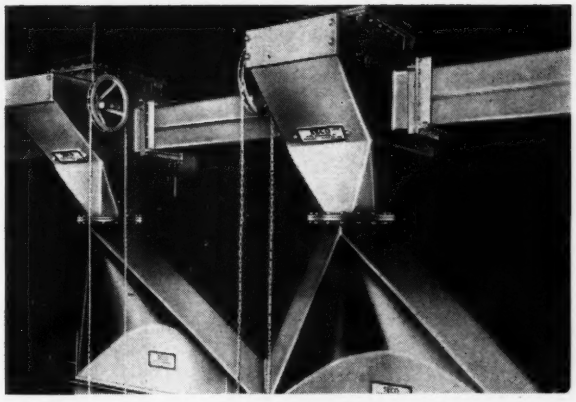


Fig. 4. Bunker-to-pulverizer arrangement for reclaiming coal from those parts of a bunker which will not feed coal by gravity to the desired points of use

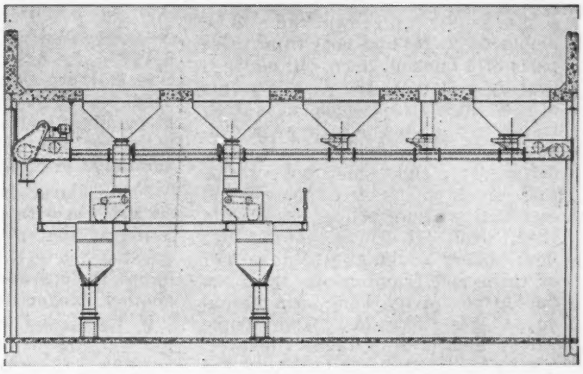


Fig. 5. Swing switch arrangement for automatic control to insure proper feeding of automatic coal scale, pulverizer, or stoker

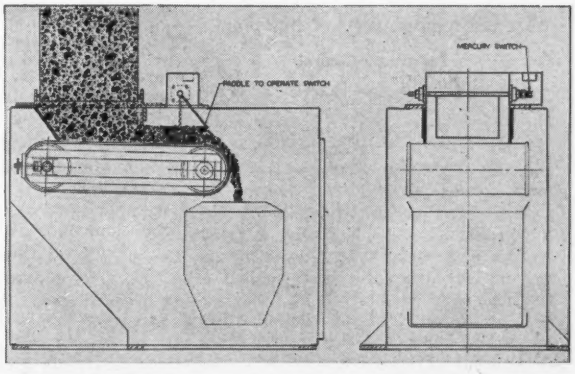
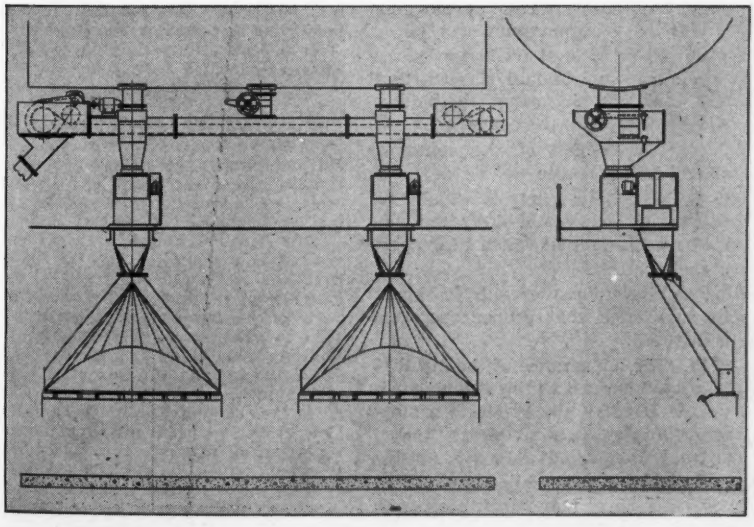


Fig. 2. (Below) Typical bunker-to-stoker arrangement with triple valve and under-bunker conveyor



At the Midwest Power Conference* Alf Kolflat, Sargent & Lundy, pointed out that the tough problems which power engineers still have to solve are centered around coal handling. The editors of POWER PLANT ENGINEERING have been aware of that fact for quite some time, and we have endeavored to present up-to-date information on all aspects of that subject. (See Wilbur G. Hudson's articles in POWER PLANT ENGINEERING, July, Oct., Nov., and Dec., 1945, and Jan., Feb., Mar., Apr., and May, 1946.) In keeping with that policy we present here another authoritative article that will help engineers to take another step toward the goal of efficient coal handling.

***(See Power Plant Engineering, page 79, May 1946)**

end view of Fig. 2 in the lower right-hand portion of the triple valve assembly. Intermediate points of feed and discharge can easily be arranged in a conveyor of this type.

Fig. 3 shows a typical "bunker to stoker" arrangement without coal scales, but with a triple valve similar to that in Fig. 2, and a drag conveyor. The direct vertical feed to the conical distributors is through the left-hand section of the triple valve; feed to the top strand of the conveyor is through the top right-hand section of the triple valve; and discharge from the lower strand of the conveyor to the conical distributors is through the bottom right-hand section of the triple valve.

This same arrangement can also be employed to reclaim coal from those parts of a bunker which will not feed coal by gravity to the desired points of use. Such an arrangement is illustrated in Fig. 4 which shows a conveyor installation in a plant originally designed for eight small boilers. All these small boilers were removed and two high pressure boilers installed in their stead. Inasmuch as the two new boilers could only obtain half of their coal requirements from the bunker by gravity, some form of conveyor was necessary. Two triple valves and a drag flight conveyor, similar to those shown on Fig. 2 and 3, were installed and arranged to meet the requirements of this plant.

Automatic Control

Automatic control is often needed to insure the proper feeding of the automatic coal scale, the pulverizer, or the stoker. The control for the starting of an under-bunker conveyor may consist of a swing switch installed directly over the feed belt of a coal scale. Fig. 5 shows a cross section of a swing switch mounted on top of an automatic coal scale. A vertical paddle, usually made of stainless steel, is rigidly attached to a horizontal shaft which turns freely in flange-mounted ball bearings. While coal maintains its normal level on the scale feed belt, the stainless steel paddle is held in an inclined position. When the coal on the feeder of the coal scale is exhausted, the paddle swings to the vertical position, thus indicating that coal is required by this scale. The turning of the horizontal shaft actuates a mercury switch and starts the conveyor. The conveyor is stopped by a stop switch which is similar in construction to that illustrated in Fig. 5, but the stop switch is usually located in the lower part of the triple valve instead of in the scale.

Requirements for Good Design

The requirements for a well designed under-bunker conveyor may be summarized as follows:

1. Horizontal cross section of chutes to conveyors, conveyor inlets, and the conveyors themselves when normally run full of coal, should be at least 15 or 16 in. square.

2. The thickness of steel plate used in the conveyor housing should be such as to give good life—particularly in sections of the country burning high sulphur coal which is very corrosive when wet. Plate of ¼ in. thickness should be considered the minimum, while ⅜ in. thickness of plate is preferable.

3. The conveyor housing should be dust-tight.

4. Hinged, gasketed, access doors should be provided at every point required for inspection or servicing, and should be equipped with suitable latches.

5. Each conveyor should preferably be fed from only one inlet at a time.

6. If more than one coal inlet is used per conveyor, provision should be made for increasing the space provided for the coal as it flows past additional inlet openings.

7. An alarm should be provided in conjunction with the conveyor installation so that if the supply of coal is exhausted at the one bunker outlet in use, the operator is notified to open another bunker outlet.

8. Conveyors should be designed for point-to-point transportation of coal. The conveyor should not attempt to circulate the coal continuously.

9. Conveying systems should be designed so that the plant can operate for a maximum period in the event of possible conveyor failure.

10. Surge hoppers between a conveyor and a scale, or between a conveyor and either a stoker or pulverizer, should have a capacity such that the conveyor is not started and stopped more than necessary.

11. The conveyor discharge should not cause coal segregation in stoker hoppers.

12. The design of chutes and downspouts should be such that the possibility of coal sticking or clogging is reduced to a minimum.

13. The design of feed connections to the conveyor should be such that any water draining out of the bunker will not collect in the conveyor.

14. The control of the conveyor should be automatic.

15. Automatic controls should be reliable in spite of the dirty and corrosive conditions in which they operate.

16. The automatic controls should be so located that proper operation is assured.

17. The appearance of the installation must be neat as this equipment is on the front of the boiler. Ungainly structural supports are undesirable.

18. The feeding capacity of the conveyor should be only slightly more than the maximum burning capacity of the boiler or boilers being fed. Too high a conveyor capacity means too many starts and stops of the conveyor.

19. The location of conveyor parts, chutes, valves, supports, and other related equipment should be such that operators cannot injure themselves on projecting corners or eye-level obstructions.

Comments

In many plants, under-bunker conveyors are installed only as an auxiliary method of feeding coal to the boilers. With this in mind, many engineers feel that it is not necessary to make the conveyor installation in a first-class manner, but will instead trust that some compromise arrangement will prove to be satisfactory. Such an attitude is an unwise policy since sound boiler room practice demands that all equipment in a boiler room should always be reliable and ready for operation if an emergency arises. I trust that this discussion will cause both users and manufacturers to insist that the design and installation of under-bunker conveyors be put on the same high plane as installations of other boiler room equipment.

Hand-Fired Warm-Air Furnaces

UNDER THE TITLE, "Rating Equations for Hand-Fired Warm-Air Furnaces," Engineering Experiment Station of the University of Illinois, has issued Circular No. 51 which presents revised gravity rating equations applicable to present models of gravity furnaces. The authors of the circular are Alonzo P. Zratz, Seichi Konzo and John A. Henry.

It is stated that the Standard Code rating equation, adopted by the National Warm Air Heating and Air conditioning Association in 1922, related the physical dimensions of the furnace with the heat output stated in terms of heat delivery at the registers. More recently with the advent of unusual models of gravity furnaces, some limitations of the original proposal for stating furnace performance have become apparent.

As a result of restudying the original test data, the rating equation has been revised. This analysis has been made with the co-operation of the Research Advisory Committee and the Installation Codes Committee of the National Warm Air Heating and Air Conditioning Association and the Association has adopted the revised rating equations.

This circular, therefore, presents revised equations for (1) all hand-fired coal furnaces converted to stoker, oil, or gas firing; (2) hand-fired furnaces having ratios of heating surface to grate area of more than 15 and less than 25 to 1; and (3) hand-fired furnaces having ratios of heating surface to grate are of more than 25 to 1. A comparison of the application of the revised rating equations with that of equations previously used is given, as well as discussions of the rating of forced-air furnaces and pipeless furnaces.

How Cathodic Protection

Prevents Pipe and Tank Corrosion

Theory of cathodic protection . . . Advantages . . . The cathodic protection battery . . . Preliminary steps to installation . . . Conducting a current survey for a pipe line . . . Test points . . . Pipe-to-soil potential . . . Current required for protection . . . Ground beds . . . Current sources . . . Current density requirements for tanks . . Effect of ice on corrosion . . . Record of protection system for a tank . . Costs

IN RECENT years the widespread and successful use of cathodic protection methods of preventing corrosion in underground pipe lines and water storage tanks has been attracting considerable attention. Some of the skepticism aroused by unfavorable results reported from early and often incorrect applications has been overcome by the good results obtained by the petroleum industry in using cathodic protection methods to prevent corrosion in pipe lines buried in the ground. As a result, power and plant engineers in industry, faced with corrosion problems in buried pipe lines and water storage tanks and concerned with maintaining continuous service to industry, are studying the practices of the petroleum industry in cathodic protection and applying them to industrial plant problems.

This article proposes to discuss the fundamental principles and applications of cathodic protection methods applicable to industrial plant conditions without too much detail about the theoretical aspects of corrosion itself which have been well covered in recent literature.

Power and industrial engineers are probably most interested in methods of preventing corrosion in:

1. Buried pipe lines carrying various liquids and gases, to avoid having to dig up and replace or repair these pipes with resultant interruption of service and increased maintenance charges.

2. Water storage tanks—for fire protection systems, process and plant water storage, boiler feedwater storage and other plant uses—to prevent leakage, service interruptions and high maintenance charges from frequent necessity for painting or coating them.

For underground pipe lines, two methods of cathodic protection are possible: 1, galvanic; 2, electrolytic, both to be explained below. The electrolytic has so far been used more extensively but present developments in lowering costs of some of the materials used may lead to wider applications of the galvanic method. For water storage tanks the electrolytic method seems to be the only effective method at present.

Before showing how these methods are carried out let us understand first the relatively simple principles underlying corrosion as shown in Fig. 1.

Cathodic Prevention of Corrosion

Corrosion is an electrochemical phenomenon, caused by differences in potential between various portions of the surface of a metal surrounded by an electrolyte. In a tank filled with water the water acts as the electrolyte; in a pipe buried in the ground the earth acts as the electrolyte. When there is a difference in potential there will be a flow of current, causing the metal to corrode at the positive or anodic area.

According to the theory of cathodic protection, corrosion will be prevented if a current is imposed in such a way as to overcome this corrosion current, whereupon the metal will become negative, or cathodic, to the earth (or a pile of metal) and corrosion will cease. This is the simple principle on which cathodic protection is based.

Among the advantages claimed for this type of protection are:

1. It is economical to install, because no preparation of the surface is necessary, therefore eliminating the need of digging to expose the pipe line. The line does not have to be removed from service for the installation.

2. Relatively little maintenance is required, and the line is constantly protected. In a line which is protected by a coating, small breaks become focal points for corrosion. Since the cathodic system affords uniform protection this difficulty is not present.

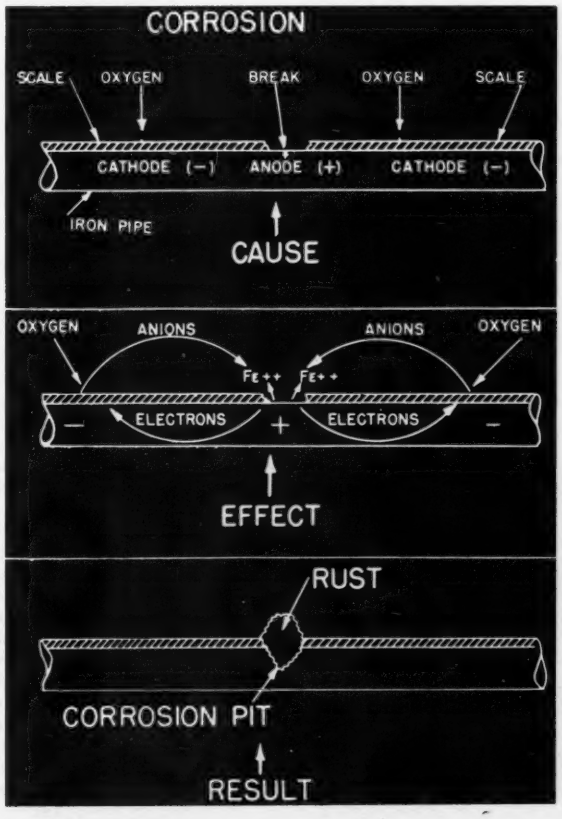


Fig. 1. Schematic diagram showing corrosion phenomena

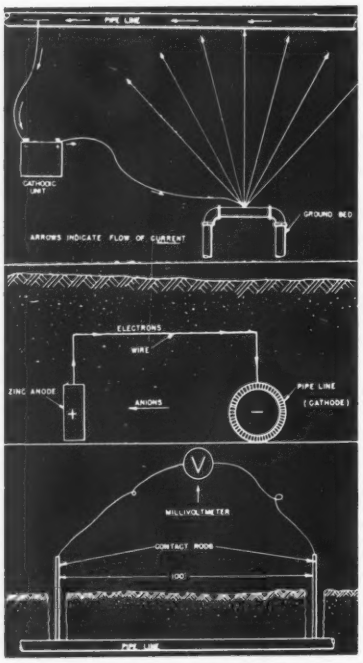


Fig. 2 (Top). Diagram showing simple electrolytic system for pipe lines. Fig. 3 (Center). Cathodic protection battery; and Fig. 4. One method of measuring pipe line potential

3. For water tanks, especially those used for fire protection systems, the fact that in many cases the tank need not be removed from service during the installation of the cathodic protection system is of great importance.

4. Cathodic protection does not change the chemical composition of the water in the tank.

5. Cathodic systems are comparable economically with other corrosion prevention methods.

For a pipeline, the simplest electrolytic form of cathodic protection consists of a source of direct current, a ground bed which is a pile of metal buried in the earth, and wires connecting the positive terminal of the source with the ground bed and the negative terminal to the pipeline, as shown in Fig. 2. The current flows from the source to the ground bed, through the earth to the pipeline, and along the pipeline to the wire leading back to the source. As a result, the corrosion occurs at the ground bed and not along the pipeline.

The Cathodic Protection Battery

If a piece of metal is installed which is anodic to the pipeline, the corrosion will take place at this metal instead of the pipeline. For example, if the line to be protected is iron or steel, a metal which is positive to iron (or above it in the electrochemical series) can be used to protect the iron. Among the metals positive to iron are zinc, manganese, magnesium, potassium and sodium.

Suppose it is decided upon to use zinc. The installation would be simple; all that is necessary are the components of any battery, namely, an anode, a cathode, an electrolyte, and a metallic connection between the anode and the cathode. The zinc is the anode, the iron pipe the cathode, the earth the electrolyte, and a wire can be connected between the zinc and the iron to complete the battery. Figure 3 shows a simple diagram of this system.

Current will flow from the zinc to the iron pipeline along the connecting wire and return through the earth to the zinc. Corrosion will occur at the zinc anode, and after a time it will be necessary to replace it. In the past this method has been considered quite costly. In view of present developments in refining it is quite likely that this method will be able to compete economically with other sources of current.

Preliminary Steps to Installing Protection

Before installing a cathodic protection system on a pipe line several preliminary steps must be considered. First, it is necessary to determine the areas, sometimes called "hot spots," where corrosion is most rapid. The difference in potential between pipe and soil must be observed, and then the current needed for protection must be determined through a trial and error process.

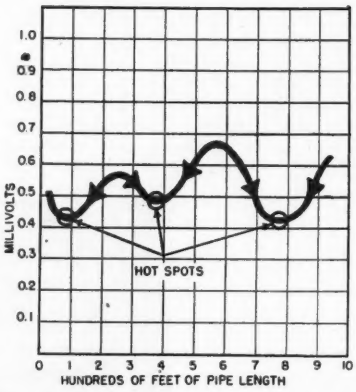


Fig. 5. Curve drawn from assumed data showing results of current survey

Locating Hot Spots

One established method for finding areas where corrosion is most extensive is that of examining the leak records. If any one area has had a considerable number of leaks it is logical to assume that this is a hot spot, and it should be given priority in installing the protection apparatus. This method is fine for pipelines which have been in service long enough to have corroded through in places, but it is obviously valueless for a relatively new installation.

Another method is that of digging bell-holes at intervals along the line and visually inspecting the pipeline. This method is costly, laborious, and not conclusive, since the bellholes cannot be economically dug at short enough intervals to cover all sections of the line, and thus corroded sections may be overlooked entirely.

Corrosion in water storage tanks and underground pipelines has been an expensive headache to engineers for many years, and many methods of prevention have been tried, with varying degrees of success and expense. In developing the idea of cathodic protection, engineers went right to the fundamentals of corrosion and worked from there. We present here a discussion of the fundamental principles and applications of cathodic protection methods applicable to industrial plant conditions, with little detail about the theoretical aspects of corrosion itself.

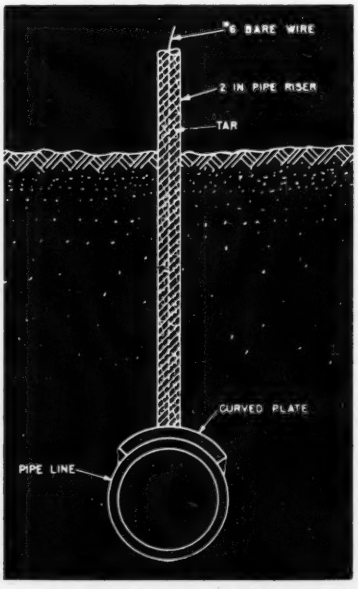
Determining the current in various sections throughout the line is the most modern method, the important data being, not the absolute value of the current, but the relative values in various sections of the line. Equipment required for this current survey includes a millivolt meter, two contact rods, and a 100 ft lead wire. The rods are placed in contact with clean exposed pipe at 100 ft intervals, the lead wire connected to the millivoltmeter and the readings recorded. See Fig. 4.

From the millivolt readings the current can be computed by the following equation:

$$I = \frac{C \times E}{L}$$

Where I is in amperes, E is millivolts
C is a constant (amps per millivolt per foot)
L is the distance between contact rods in feet

Fig. 6. Test point as it might look after installation



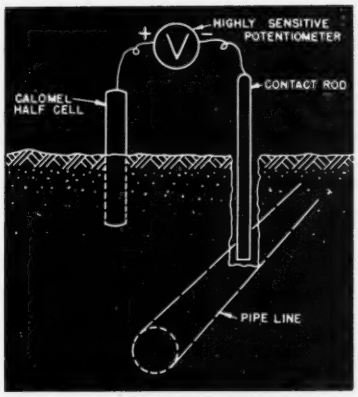


Fig. 7. One method of measuring pipe-to-soil potential

The constant C is different for different pipesizes, varying from 50 for 4 in. pipe to 203 for 12 in. heavy pipe. Roughly, it is 4.65 times the weight of the pipe in pounds per ft for sizes from 4 to 12 in.

Millivolts can be plotted against distance along the line as shown in the curve of Fig. 5. All the data for this curve was assumed since actual survey data was not available. Directions of the potential drop (current flow) are indicated by arrows. The valleys in the curve indicated points of discharge or hot spots. Peaks indicate points of greater current density.

Test Points

In performing a current survey a series of test points will facilitate the process. These test points will serve as easily accessible reference points for future check ups, and their value exceeds the time and expense involved in installing them. They insure a good electrical contact with the pipe, and eliminate the necessity of probing to locate the line.

Little expenditure for materials is required to make these test points as they are quite simple. A bare wire is brazed to a curved plate, to which is welded a 2 in. pipe riser to protect the wire, as in Fig. 6. The pipe may be filled with tar or compound to prevent the wire from falling down inside the pipe. The assembly can be prefabricated in the shops and welded to the pipeline in the field.

Pipe-to-Soil Potentials

Authorities are not in agreement on techniques of determining the potential between the pipe and the surrounding soil, so the following is merely one method for establishing these potentials. An extremely sensitive voltmeter is necessary; one on the order of 10,000 ohms per volt or greater, if possible. A non-polarizing electrode, such as a copper sulphate cell, is also necessary to prevent drawing current from the circuit. A contact rod is connected to the pipe and a lead run to the negative post of the meter. The non-polarizing electrode is placed in the earth near the pipeline and connected to the positive post, as in Fig. 7. A battery action between the electrode and the meter will take place, which necessitates correcting all the meter readings. Under ideal conditions, this reading correction is 0.55 volts for the copper sulphate electrode, but it varies under field conditions, and the figure used depends upon the experience of the engineer making the investigation.

How Much Current for Protection?

Because of the number of variables involved, attempted calculations of the amount of protective current and voltage have not proved entirely reliable. Until the engineer has installed several systems and accumulated experience to draw upon, it is desirable to conduct a preliminary test.

Equipment needed for this test includes a preliminary ground bed, a portable electric welder or a gasoline-driven d-c generator, and the necessary leads. The positive side of the generator is connected to the ground bed, the negative side to the pipeline, and the apparatus started. After allowing the machine to run a few hours so that conditions become constant, pipe-to-soil potentials are observed. If the output current is too low to counteract the pipeline currents, the amperage is stepped up, and this process repeated until the correct impressed current is found. This establishes the current required for protection.

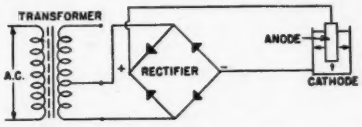


Fig. 8. Simplified diagram of cathodic protection circuit for tanks (Sudrabin)

Ground Beds

Ground beds are usually made from scrap pipe or boiler tubing or junk iron rails buried vertically or horizontally in the ground. The amount of iron used depends upon the resistivity of the soil and the amount of pipe to protect. Several pieces of pipe which are well separated are more effective than the same quantity of pipe in a single piece, but the separation of these pieces depends upon the economic feasibility of an additional anode area. In instances where there is a long stretch of line to be protected it has been found to save current if several ground beds are spaced evenly and connected together. It is the general practice, according to Brance-Krachy, to install ground beds of 40 amperes or more, 200 to 500 ft from the line, while those carrying less current are installed closer. The type of bed shown in Fig. 2 is based on a horizontal design which they recommended. It consists of two lengths of pipe laid at right angles to the line 50 ft apart and connected with a third length of pipe at the ends nearest the line. The electrical connection is made in the middle of the leg which is parallel to the line.

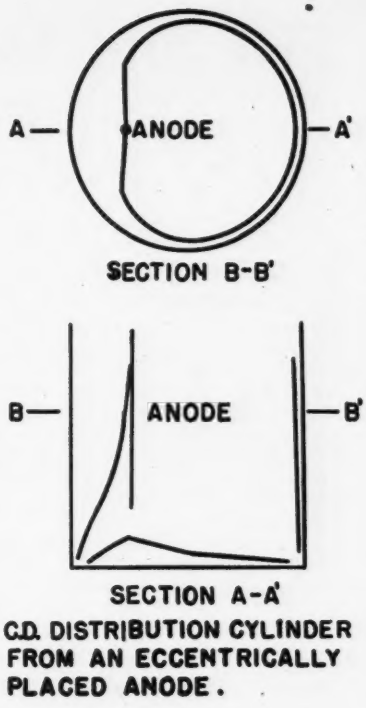


Fig. 9. Current density distribution in cylinder from an eccentrically placed anode (Sudrabin)

Current Sources

Direct current of such magnitude that it reverses the potential and thus the flow of current at the corrosive area must be supplied by the cathodic unit. In selecting the source the particular working conditions of the area must be considered as well as the capacity.

If there is a source of alternating current power located near the area to be protected, a transformer-rectifier or a motor-generator would be a logical choice. On the other hand, if the area is isolated from transmis-

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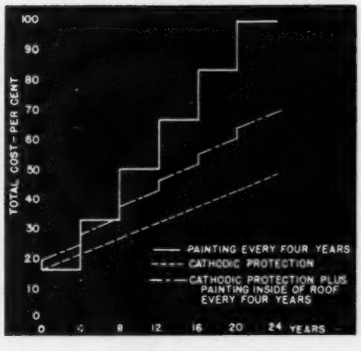
Fig. 10. A comparison of overall costs of cathodic protection vs. painting of interior tank surfaces during a 24-year period (Sudrabin)



Fisk and Northwest Stations Burn Oil to Meet Emergency

TO MAINTAIN maximum electric service for industrial, commercial and domestic consumers during the severe coal shortage in the Chicago area, Commonwealth Edison Co. of Chicago has made emergency installations of oil burning equipment to fire seven high-pressure steam generating units at Fisk and Northwest Stations. This conversion program will permit these units, which have heretofore been fired with pulverized coal, to supply steam for turbine generators with a total capacity of 360,000 kw.

Installation of the oil-burning equipment began on May 2. The equipment installed consists of oil burners in the furnaces and the necessary piping, oil heaters and pumps for supplying oil from tank cars. On the above data the Illinois Commerce Commission ordered reductions of industrial and commercial electricity usage to 24 hr per week and curtailed non-essential uses of electricity with the object of attaining a 40 per cent reduction in Chicago and Northern Illinois. On May 13, the commission lifted the most drastic phases of the "brown-out" because of the coal strike "truce," and by that time the anticipated reduction in kilowatt-hour consumption had been substantially attained.

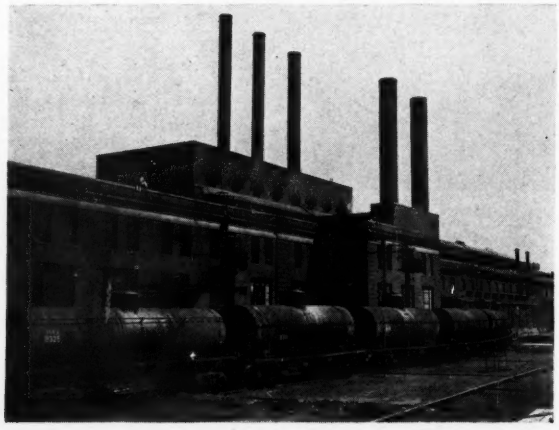


Fig. 1. Exterior view of Fisk Station, showing tank cars in which fuel oil is heated. Temporary steam lines and platforms are shown between the cars

Fig. 2. View at one of the burners of a Unit 15 boiler, showing how steam-atomizing oil burners were installed. At bottom is oil supply header, from which flexible hose connections will be made to individual oil burners

Fisk Station

At Fisk Station, Unit 15 consists of two B & W boilers each of 375,000 lb per hr capacity supplying steam at 1200 psi, 900 F to an Allis-Chalmers 30,000-kw topping turbine generator. This topping unit, along with its low-pressure turbine generators, has a total generating capacity of 85,000 to 90,000 kw. Unit 17 consists of two B & W boilers each of 750,000 lb per hr capacity that supply steam at 1250 psi, 925 F to an Allis-Chalmers 147,000-kw condensing turbine generator. (See Power Plant Engineering, October, 1944.)

Between May 2 and May 10, two crews of 30 to 40 men each, working 12-hr shifts, installed and made ready for operation the oil handling system and 16 oil burners on one boiler of Unit 15. The following day the oil firing equipment of the second boiler of Unit 15 was placed in operation. In another 10 days oil firing equipment was ready on Unit 17.

Provisions for Oil Supply

Bunker C oil is being burned in these units. It is brought into the station property in standard railway tank cars and provision has been made for spotting 12 such cars on

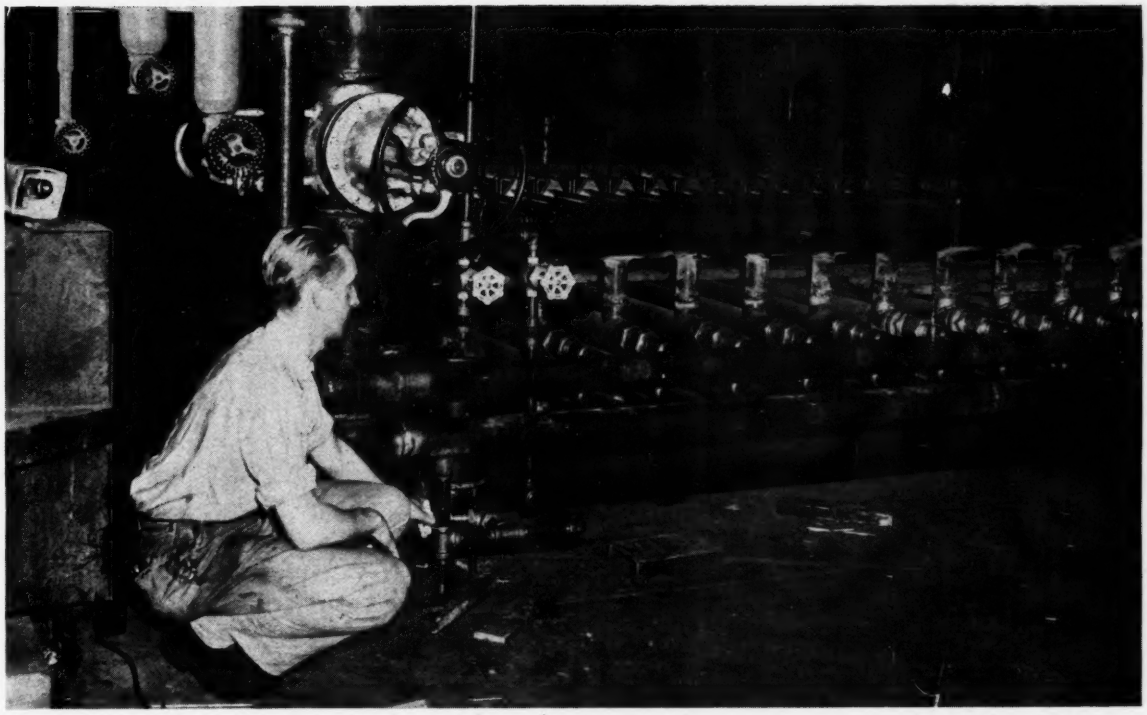


Fig. 3. View of the G-fin section fuel oil heater, consisting of 30 sections welded together on the job, for heating 480 gpm of fuel oil for Fisk Unit 15 and 17 boilers

two railroad tracks on the property adjacent to the boiler room. Four of these cars are held as standby storage, the other eight are the normal supply. The oil is heated with steam in the cars, flows to two transfer tanks, and from these is pumped through an oil heater to the burners. By May 7, approximately 1250 tank cars of oil were on order and some had been delivered. Oil cars are being delivered according to requirements for burning the maximum amount of oil in order to conserve the coal supply.

Steam piping for heating oil cars in the yard and in location adjacent to the station had to be installed; also, piping for drawing the oil from the cars was necessary. The two transfer tanks into which oil flows from the cars are 5000 gal steel tanks, one fabricated on the job, one purchased from a local contractor.

Pumping and Heating Oil

From the transfer tanks, three motor-driven centrifugal pumps withdraw the oil and pump it to the oil heater. Two of these pumps, of 250 gpm capacity each, were on hand at the station. The third pump, of 750 gpm capacity, was converted from other service to be used in the oil firing job.

The oil heater was connected on the job by welding together 30 Griscom-Russell G-fin heater sections in parallel, as shown in Fig. 3. This heater has a capacity of 480 gpm and heats the oil from 100 F to 225 F for delivery to the burners.

Piping and valves for the various oil and steam lines were obtained partly from stocks on hand for another construction purpose and partly through the cooperation of Crane Company. Oil supply lines were equipped with Henry Pratt Y-type strainers, as shown in Fig. 4, taken from water lines in the plant and adapted to the oil line service by inserting finer mesh screens.

From the oil heater, the oil is delivered to the burners through a

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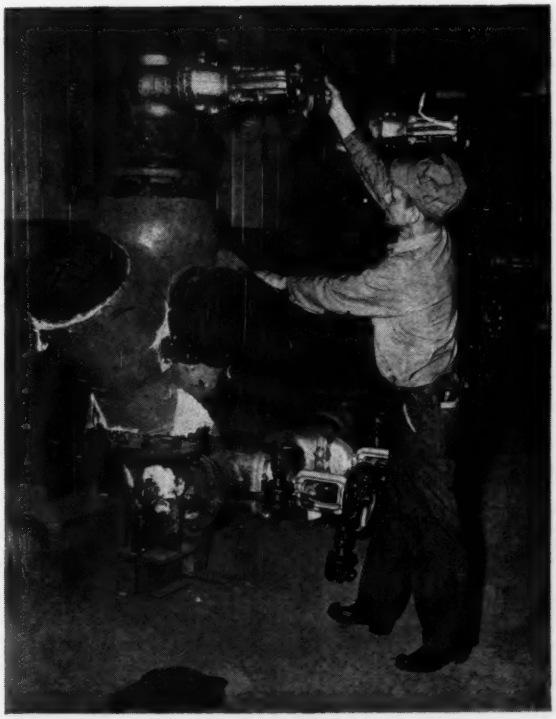


Fig. 4. View of one of the Y-type strainers taken from another service in the plant and installed on oil supply lines at Fisk Station

Holding Power Plant Auxiliaries During Power Disturbances

Here's practical help on a common industrial power plant problem. . . Such plants must maintain continuity of service for industrial production. . . But if plant has no outside power connection—and even if it does—electrical disturbances may produce momentary voltage drops, causing motor starter holding coils to release contacts, shut down motors of m-g exciter sets on generators, shut down motors of pulverizers, feeders, fans. . . This will shut down entire plant, causing delays in re-starting, trouble, loss of production. . . Such a failure may cost author's company not less than $20,000. . . To prevent it, he shows how they have installed a new method of connecting and controlling motor-driven power plant auxiliaries. . . Makes and types of equipment

By Theodore Maynz

In Charge of Steam & Electric Power Generation & Distribution
American Viscose Corporation

ONE OF THE less desirable features of an isolated industrial power plant is the liability of losing the power house auxiliaries in the event of an electrical disturbance. This is particularly bad in the case of pulverized-fuel-fired boilers, with which the loss of power to the motors driving the fans, pulverizers and feeders means immediate loss of steam pressure. Any electrical disturbance which will reduce the voltage sufficiently for the starter holding coils to release the contacts (under-voltage protection) will usually cause a complete failure of the steam supply. Once burner ignition is lost, the furnaces must be purged to prevent explosion hazards, all of which takes time and delays restarting of the station.

Even if parallel operation with a Public Utility connection is used, a severe electrical disturbance, on either source of power, usually will trip out all or most of the magnetic starters. Standby power, not regularly connected to the industrial power supply, cannot be connected in time to save a power loss. Moreover such standby power is usually very expensive, inasmuch as it requires a large contracted supply to start the large motors used with pulverized-fuel boilers. Again there is the time delay to restart the fans, purge the furnace and start the mills, which are usually plugged under such unscheduled shutdowns.

Unless shaft exciters are used, an electrical disturbance usually means the immediate loss of excitation, and thus of power from the generators. Even with shaft exciters, the loss of steam slows down the turbines so that it is only a few moments before there is insufficient speed for maintaining excitation.

The trend towards electric auxiliaries for stoker fired boilers makes this type of unit almost as sensitive to power failure as pulverized fuel equipment.

Why the Problem Is Serious

Due to war time overload and insufficient maintenance, we have had a number of power failures in our plants, so that this subject has become increasingly important. Since a power failure costs our Company not less than $20,000 in material and labor losses, we are naturally interested in methods for maintaining power at the switchboard so that in event of trouble, power to the mill may be restored as promptly as possible. Inter-connection with a Public Utility is impractical and, although we have a standby connection in some of our plants, this service only helps to start one boiler in case of a complete Power House shutdown.

We have had particular trouble with our pulverized-fuel-fired plants, of which three are completely, and two partially, equipped with pulverized fuel, in restoring steam pressure after a power disturbance. With our overloaded plants and practically no reserve units in operation, the loss of a generator, or an induced draft fan, has been sufficient to cause a power outage.

New Method of Solution

To solve our problem, we have started to install a new method of connecting our station auxiliaries. Our smaller motors have magnetic across-line starters, and the larger ones have either hand or magnetically-operated reduced-voltage compensators. The CR-1034 hand-operated compensators are being equipped with Type CR-2870-1062 escapement-type time-delay relays. For our m-g set exciters, we use at present some means of blocking the handle of the compensators, either by a wooden block between the handle and the wall, or by a bracket and a bolt to block the handle in the "run" position. This will probably be considered rank heresy by most engineers, but it works, and we maintain excitation to the very end.

We considered the use of two-wire control on our magnetic starters, but did not like this for several reasons, such as complications for multi-station push buttons, and also for fear that the operators will forget to open all of the motor circuits, after a failure. We also considered the use of CR-2942-2A-15 time-delay push buttons for the magnetic starters, but these would not be satisfactory for boiler auxiliaries, due to their interference with sequence control.

Details of New Control Equipment

We therefore decided on the use of electrically-operated, mechanically-held relays in the control circuits of our starters, d-c-operated by our station control battery. We chose Cutler-Hammer Bulletin C-6011 contactors with one set of main contacts in the holding coil circuit, in place of the usual starter coil holding contacts. (These unused starter contacts can then be used for sequence control, as shown in the accompanying diagram.) Starting and stopping of the motor is controlled by momentary contact (N. O.) push buttons or pistol-grip

switches. In our case, these pistol-grip switches, mounted on the boiler gage board, are SB-10, which also reset the overloads on the E C & M reduced-voltage starters by pulling the handle straight out, when in neutral position.

Even though we have sequence control on all our pulverized-fuel boiler auxiliaries, we are using a multi-contact pistol-grip switch in parallel with the "Stop" push buttons of all the relays. This switch, mounted on each boiler gage board, can trip all of the boiler auxiliary motors at the will of the operator. This switch, a Westinghouse Type WL (8 pole), has a trip coil. This trip coil is actuated by a Westinghouse Type CV, circuit-closing, undervoltage, time-delay relay, with the holding coil connected across the 440-v auxiliary power bus, and trips all of the WL switches. This is the only coil that is normally energized, since the relay coils are only energized when motors are started or stopped.

How It Operates

The operation of this equipment is easily seen from the diagram. The mechanically-held relays act as 2-wire control, so that if a momentary voltage dip should occur, sufficient to allow the starter contacts to open, the coil-holding circuit is still maintained so that if the fault clears, all the motors will re-start. Since there is sufficient WR^2 in all of the auxiliaries, a momentary power failure will not slow down the fans or pulverizers too much for automatic restart.

If the fault clears before the main generators trip out, this full-load application is not serious. However, if the fault does not clear, and power is actually interrupted, then the time-delay relay will, after about 1 or 2 seconds, trip the WL switch, and thereby open all of the starters automatically. The WL switches and Type CV relay are hand reset.

Variations of the Scheme

There are several possible variations in this scheme. If no station battery is installed, but if a reliable outside source of power is available, then the C-H Bulletin 9575, a-c-operated, mechanically-held contactor can be used in place of the Bulletin 6011. Or an Allen-Bradley Bulletin 700, Type BM, electrically-operated, mechanically-held relay can be used.

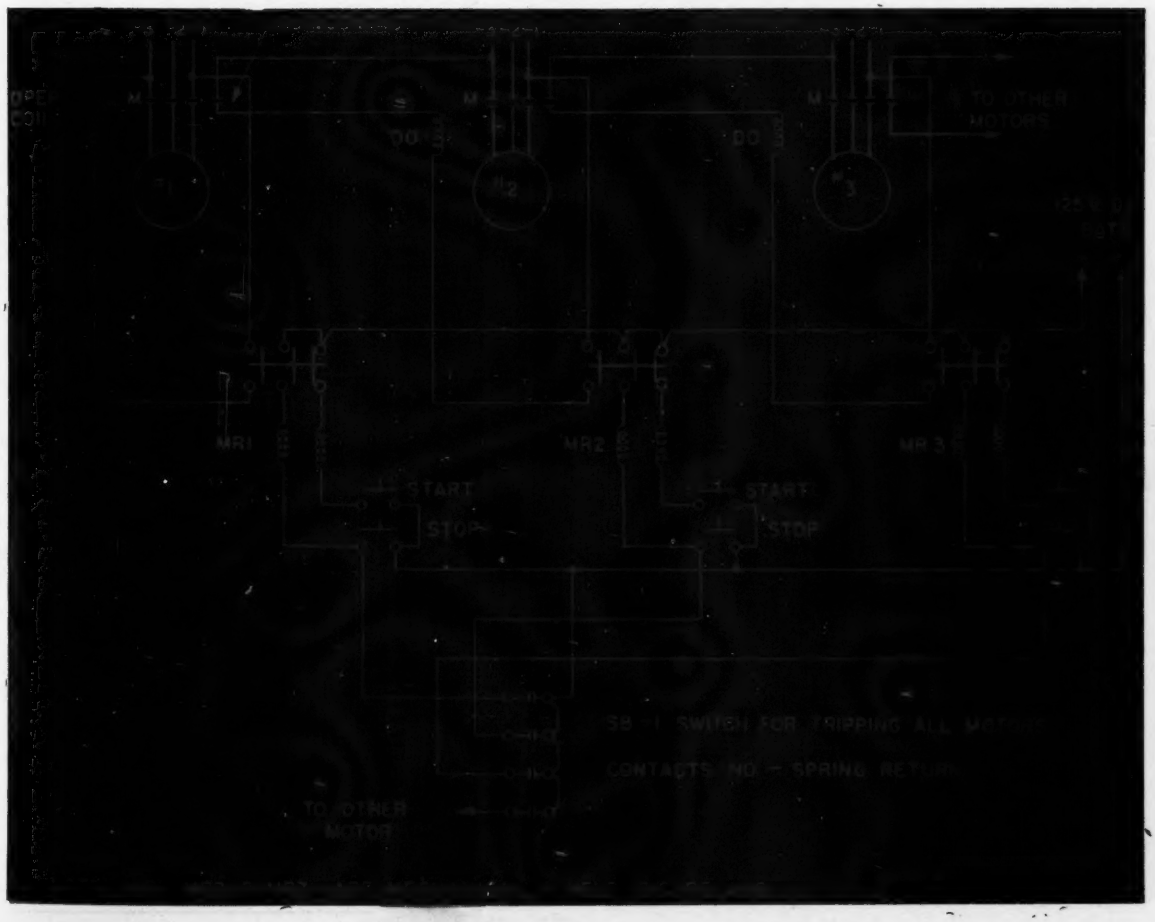
This is the method we intend using in our next installation in a plant in which we have no battery, but do have an outside power connection.

By using additional contacts on these relays, the motor red and green indicating lights can be wired to these contactors, and the usual indicating light relays eliminated. Naturally, with additional relay contacts, other signals, lights or operations can be used.

Use with House Generators

These relays should be particularly helpful with the use of turbine house generators, which we are in process of installing or purchasing for most of our plants. These house generators will be directly connected to our power plant service transformer feeder, and to the main generating bus through a relay-controlled bus-tie switch. The relays will open this bus-tie switch either on under-voltage or under-frequency. Thus, with the opening of the bus-tie switch, the house generator will pick up the load, and all starter contacts will close again immediately on restoration of voltage and frequency to the auxiliary bus.

Although we have an installation completed, we have not yet been able to test it with a simulated electrical outage. We expect to make such a test this summer, when we will have a manufacturing plant shutdown for new construction tie-ins, and thus can isolate a boiler and generator for test of the installation.



Wiring diagram for mechanically-held d-c relays with sequence control of power plant auxiliary motors

Cathodic Protection

(Continued from page 85)

sion lines, gasoline-driven d-c generators might be used. If weather conditions are such that wind velocities are high enough over long enough periods, wind chargers may be used. These have been expressly developed for cathodic units, and certain sets have storage batteries which are charged while the wind is blowing and which are automatically placed in the circuit when the wind velocity falls below a predetermined minimum.

Maintenance costs are high for gasoline units and wind chargers whereas they are comparatively low for the motor generators. Since there are no moving parts in the transformer-rectifiers, their maintenance costs are very low. Recent developments have reduced the costs of rectifiers so that their prices can compete with motor-generator prices.

Summarizing, the factors to be considered in selecting a current source are:

1. Location of transmission lines.
2. Availability of fuel for gasoline-driven units.
3. Wind velocity in area.
4. Accessibility of area.

Cathodic Protection for Water Tanks

In practically all cases, corrosion is more severe on the inside of tanks than on the outside, and on the bottom than on the side walls. Insoluble substances covering portions of the bottom of the tank cause corrosion to occur more rapidly because the covering prevents the dissolved oxygen in the tank from coming in contact with the metal. The areas adjacent to the covered portion become more accessible to the dissolved oxygen, which is cathodic to the metal underneath, and corrosion currents flow from the metal to the dissolved oxygen. Unrelieved stresses from construction may become focal points for corrosion. A simplified diagram of a cathodic circuit for tanks is shown in Fig. 8.

Case History of Tank System

A case history of a cathodic protection system installed on a water tank is given by Sudrabin as follows:

"A practical example of the effectiveness of cathodic protection is illustrated by an installation in a 100,000 gallon elevated tank with an ellipsoidal bottom in Dayton, Ohio, which was built in 1931. The tank was initially painted with one shop coat of red lead and then covered with a field coat of red lead after erection. The tank water level was automatically maintained with a fluctuation of about two feet between high and low water. In 1939 several leaks developed in the bowl of the tank resulting in the need for immediate repair. The leaks and most of the pit depressions were repaired by welding. The AWWA specifications previously mentioned state that 'Such a leak indicates that the entire bottom may be thin and other leaks may soon appear. The use of welding to patch such leaks is of very doubtful economy as the heat of welding very often is the cause of new leaks. Even if a considerable area is welded, it may be but a short time after such repairs are made before new leaks appear.'

"After repairing the tank bowl in 1939 a cathodic protection system was designed and installed in this tank. An examination of the tank bowl, vertical walls and riser, in the summer of 1944, showed these surfaces to be in very good condition and that the tank should serve without further repair for many years."

Effect of Ice on Corrosion

Steel coated with ice is attacked so little by corrosion that the effect may be considered negligible. Thus, the protecting anodes may be removed from the tank just before ice forms on the submerged surfaces of metal and replaced as soon as the ice melts.

Ice has an extremely high electrical resistance, so a heated anode has been considered to provide protection when only parts of the surface in contact with the corrosive water are coated with ice. The use of this system depends upon the peculiarities of ice formation in the particular installation, and calls for a tailor-made system.

Current Density

"Rules of thumb" have been generally used to determine the current density necessary to afford protection for various installations. Excessive current density is not as harmful to iron and steel as it is to the more amphoteric metals such as aluminum, yet first costs and operational costs necessitate the establishment of the correct current required before the installation is made.

Current density requirements increase with increased dissolved oxygen content and with increased agitation, and work done by Sudrabin has indicated that, in quasistagnant water containing less than 1.0 ppm of dissolved solids, 0.1 N and 1 N sodium chloride solutions, with controlled oxygen concentration in the bulk of the media (water), the current density requirements for complete protection vary directly with the dissolved oxygen concentration and are relative independent of the salt concentration.

Calcium and magnesium salts in the water lower the current density required for protection because they form a deposit on the surface when even the smallest natural corrosion current starts which reduces the amount of dissolved oxygen which reaches the cathodically active surface.

Correct current density distribution does not result from geometrically centering the anode in the tank, as might be assumed. Figure 9 shows results of a current density that reveal facts contrary to expectancy.

Economic Considerations

"The prime purpose of any method of corrosion control," says Sudrabin, "is to obtain the maximum useful life and the most satisfactory service from the structure being protected at the lowest overall cost. Failure to properly protect the submerged surfaces of a structure, such as a water tank, will in many cases result in a much greater depreciation rate of the tank than was anticipated at the time it was purchased. The financing and operating problems incurred by the need for early replacement or repair of the tank structure should be guarded against by a planned tank protection system."

Costs

Cost of cathodic protection differ greatly depending upon the type and location of the installation. For pipe lines, the initial cost of anodes, power sources, and transmission line is between $500 and $2000 per mile of line. Theoretically, the current required for protection is of the magnitude of the line current, but in practice it is found to be considerably higher. Several companies have reported their pipe mileage and power consumption, but it is not known whether their lines are over or under protected. A graph showing comparison of overall costs of cathodic protection for tanks is shown in Fig. 10.

Robert J. Kuhn states: "It is a proven fact that cathodic protection of pipelines is very practical in a city network even in the most crowded quarters, but such installations should be extremely well designed with a thorough knowledge of the behavior of stray currents, of coating characteristics and many more features and details which, if ignored may result in bad design and operation and eventually cause more damage than protection."

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The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

☆

Great Oaks . . .

An electric device ". . . from a pipe cleaner grew." How? It seems that the Navy was having trouble with enclosed cooling systems for driving motors on some of their ships. Air from ventilating units is cooled by being passed over steel pipes through which cold sea water flows. On some types of ships, these pipes developed leaks, and since the system is enclosed the leaks went by unnoticed. In time salt water collected on and ate through insulation on the motor windings and eventually caused motor failure.

General Electric Co. engineers found the answer to this problem in a humble pipe cleaner. Noting that the pipe cleaner is made of two fuzz-covered wires, they connected these wires to an electric relay and found that water collecting on the fuzz energized the circuit, and a light was caused to flash. Enlarging on this idea, porous glass tape was wound around a metal tube. Then stainless steel wire was wound around the tape, so that, connected to an electric relay, this circuit became energized whenever moisture of a certain degree was absorbed by the glass tape.

Installed in ships, this glorified pipe cleaner was placed so that any leakage collected on the glass tape; then the circuit closed and a signal flashed outside the cooling system.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
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Making Steam Is a Complex Business

By John C. Gore

In our everyday work we are inclined to take many things for granted. Often, we are so concerned or engrossed with details that we forget to evaluate the requirements, at least the importance of the job we are really trying to do. This is as true in the power plant as it is anywhere else. In a boiler plant for example the operators may be so concerned with the details of keeping the plant running that they rarely stop to think of what they are really doing or of what is happening in the assembly of equipment known generally as the boiler or steam generator. As is pointed out by the author in this interesting article, basically the process of generating steam is simple but actually it is complicated—very complicated, and it would do any operator good at times to think of the steam generating process as a whole and analyze what is going on at all the various points of the system.

Now, this is exactly what John Gore does in this article. Some two years ago while he was employed as a service man for a large boiler manufacturer, during the small hours of a night when he was passing the time in a boiler plant, he made some notes, mostly to amuse himself. Operating had been smooth during the preceding hours and the steam generating unit was performing quietly and effectively.

Perhaps, you have such a unit yourself. Shining in a new dress of aluminum paint and towering 60 or 70 ft above the operating floor, it represents the last word in boiler design. The noises it makes are soothing and comforting to the operator because they tell him that everything is well. The noise of air rushing through the draft system, the low rumble of the pulverizers, the shrill scream of high pressure steam through the lines, are all noises that are music to the engineer who knows his business.

Mr. Gore's thoughts were of this character as he sat there that night. As he watched the operators going about their duties in a peaceful manner and realizing that the scene could change to one of extreme hurry and activity by the simple change of tone of any of the medley of sounds, he began to try to imagine just what was going on in the assembly of equipment before him. He made notes and these notes, subsequently amplified, form the basis of his article. While it contains nothing particularly new to the experienced operator, the way in which the thoughts are presented and the overall picture which they give of the operation of the boiler as a whole should be of value and interest to any man who is a boiler plant man at heart. Read it and see if it doesn't give you greater pride in the job you are doing.

THE MODERN HIGH PRESSURE STEAM BOILER is in reality a huge container for carrying out a series of highly complicated technical processes. When we attempt to conceive of this function in the fullest sense it is then understandable why so much care and thought is given to the design, fabrication and operation of this equipment.

Basically all such equipment is designed and built with the primary purpose of liberating heat from an energy source known as fuel, and of transferring this heat to a practical heat transfer medium such as steam. This primary function is accomplished by bringing fuel, air, feedwater and feedwater chemicals together in the proper place, at the right time and in the correct proportions to produce a certain quantity and quality of steam or other heat transfer medium. The accomplishment of this purpose presents a group of problems which, even today after many years of study, have not been completely solved. However the solution of these problems is the basis of efficient, safe and dependable operation, and as such, the known answers to the problems cannot be neglected or minimized if the best in operation is desired.

Any concept which the mind may form of the modern steam boiler must include a realization of the chemical and physical processes that take place in this equipment. Without this realization it is impossible to appreciate the technical nature of the processes involved or the importance and complexity of the duties arising out of the operation of such equipment.

First, the fuel must be burned in such a manner that the available heat is released. This process in the ordinary sense is referred to simply as the combustion process, however the process is not simple, nor in any sense can it be termed ordinary. This is a complex chemical process requiring the correct proportioning of the fuel and the air and the proper mixing of these two substances with the resultant exothermic reaction occurring at the proper place at the right time, which accomplishment requires considerable skill and care on the part of the operator. Millions of dollars have been spent to accomplish this end and many men have spent countless hours thinking of ways to improve this process.

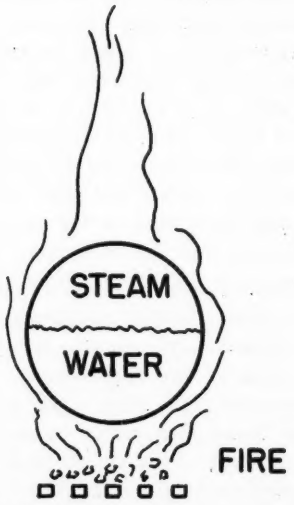

Fig. 1. Basically the process of steam generation is simple

Since men in the far distant past discovered that fire could be useful, the search for new methods of controlling this reaction so as to increase the safety, dependability and efficiency of the combustion process has been followed throughout the centuries. It is probably one of the oldest of known sciences of men and from it has come a great many answers to the secrets of the liberation of energy for men's use. A vast store of knowledge has been accumulated and scientific theories have been formulated to explain this process but the basic reason for the release of heat and the reason why the reaction actually occurs have not been clearly established and the search continues for the answers to these problems.[1]

On the Gas Side

After liberation of the heat in the furnace of the steam generator this heat must be transferred from the hot gases to the metal surface and through the metal to the water or

heat transfer medium. This transfer by radiation, convection and conduction involves a number of laws from the science of physics. The heat transfer process may be impeded by various conditions such as slag or ash on the metal surfaces and the effect of stagnant air layers adhering to such surfaces due to molecular attraction. The slag and ash formations are objectionable from a basis of heat transfer and in addition the problem of their removal and ultimate disposal is of major importance to the operator. The chemical attack of the metal tubes by the molten slag presents a whole new field of chemistry at high temperatures in that there is reason to believe that the slags at high temperatures undergo a chemical change which permits certain substances to form which attack the metal surfaces. It is impossible to list and describe the various problems and the vast amount of research that has been undertaken in answer to these problems concerning slag and ash but here again many men have spent and others will spend, the major portion of their lives in searching for knowledge in this field alone.

On the Water Side

On the water side of the metal surface a condition exists which is as confusing as that mentioned in the fire side. The metal in this instance is giving up heat to the water and steam is being formed. This physical transfer of heat to the final heat transfer medium is complicated due to the existence of water in a partially liquid and partially vapor state. Here again stagnant molecular boundary conditions between metal and water or vapor make any theoretical heat transfer solution impractical and this condition must be eliminated in order to effect as rapid a transfer of heat as is possible to prevent trouble. The scientific laws governing such a transfer to a water vapor mixture are interpolated to give practical solutions

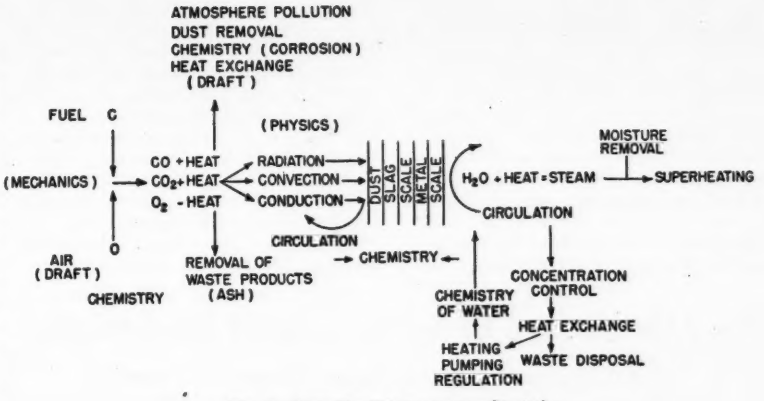

Fig. 2. Actually, it is very complicated

to the problem by using actual test data which is accumulated in such a way as to account for the variables of tube size velocity of water vapor mixture surface smoothness and percentage of vapor in the water vapor mixture. The last mentioned variable is also of importance as it accounts for varying densities of the mixture at different locations in the steam generator and this results in natural circulation of the liquid through the unit during operation.

As the water is vaporized by the transfer of heat from the metal surface the minerals and salts originally in the water become concentrated due to loss of water in the vapor state. This concentration can become dangerous as a continuation of the process will result in solid deposits of the salt and minerals in the form commonly known as scale. The process is accelerated by the high temperatures which aid in precipitation of scale forming minerals due to chemical changes. This scale has a low rate of heat transfer and results in a reduction of heat transfer rates from the metal to the water and such a stoppage of the flow of heat may result in overheating and subsequent failure of the metal part. Such a failure is dangerous in a steam generator as it is a huge pressure vessel and necessitates the shutdown of the equipment for repairs. To eliminate harmful deposits of scale, water chemistry is employed to produce water free of scale forming salts and to produce salts which readily stay in solution under normal concentrations of boiler water. This science of water treating has grown rapidly during recent years and today many companies specialize in this business. No two localities possess exactly the same type of water, each locality having water bearing different minerals and combinations of minerals. The further fact that most known natural waters contain varying amounts of dissolved gases which when released under high temperature conditions are extremely corrosive to ordinary steels adds numerous details to the water chemistry problem. A complete understanding of all these problems and their eventual solution still awaits the day when research on these questions can be completed. This search for knowledge of ways to economically eliminate the troubles arising due to the water used in steam generators continuous day and night in the chemical laboratories of the world and this intense effort will probably continue as long as water suitable for steam generation is demanded by the power engineers.

When all of the above factors are considered objectively as well as others too numerous to mention for lack of space, it becomes evident that a boiler is in reality a piece of equipment in which some of the most complex of chemical and physical changes are taking place. To satisfactorily operate such a piece of equipment requires ingenuity, skill and a knowledge of chemistry, physics and metallurgy. It is therefore apparent that only the very best in design as well as the most intelligent and correct knowledge of operation can even approximate the results desired. Here is a field of opportunity for any person interested in exploring new engineering frontiers where there is room for unlimited discoveries and so very

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[1]Editor's Note: The basic reason for the release of heat in the process of combustion lies in the release of the so-called binding energy of the atoms. It really represents the loss of mass predicted in the Einstein equation $E = mc^2$. Thus, when two gram-molecules of hydrogen and one of oxygen combine to form water, the reaction evolves 136,000 calories. In a purely chemical reaction such as this, the actual loss of mass of the hydrogen and oxygen represented by the 136,000 calories cannot be measured by even the most refined methods available to us. In nuclear reactions, however, this loss of mass is apparent and in all of the recent work in nuclear physics in connection with the development of the atomic bomb, this loss of mass enters into the calculations. Thus, when lithium, ${}_3Li^7$ is bombarded by hydrogen ${}_1H^1$, helium is produced in accordance with the following equation:

$$ {}_3Li^7 + {}_1H^1 \longrightarrow 2\ {}_2He^4 + e $$

where e stands for energy.

Thus, the combination of 7 grams of lithium and 1 of hydrogen will produce 8 grams of helium and in addition 5 billion calories. This is a stupendously greater amount of energy than that released in the chemical combination of hydrogen and oxygen.

Now, the mass of a single atom of Li^7 is $7.01818 \times 1.66 \times 10^{-24}$ gram. And the mass of a single atom of hydrogen H^1 is $1.00813 \times 1.66 \times 10^{-24}$ grams. Helium on the same basis weighs $4.00389 \times 1.66 \times 10^{-24}$. Hence, if we put these values in the above equation, we get

$$ \underbrace{7.01818 \times 1.66 \times 10^{-24}}_{Li^7} + \underbrace{1.00813 \times 1.66 \times 10^{-24}}_{H^1} \longrightarrow \underbrace{2 \times 4.00389 \times 1.66 \times 10^{-24}}_{2\ He^4} $$

$$ \underbrace{8.02631}_{} \times 1.66 \times 10^{-24} \qquad\qquad \underbrace{8.00778 \times 1.66 \times 10^{-24}}_{} $$

It will be seen that the two sides of the equation do not balance; there is an excess of $0.01853 \times 1.66 \times 10^{-24}$ on the left hand side of the equation. This is a loss of mass in each individual reaction of 3.16×10^{-26} grams.

According to the Einstein mass-energy equivalence relation $E = mc^2$ the energy release per individual reaction is therefore, $3.16 \times 10^{-26} \times (3 \times 10^{10})^2 = 2.76 \times 10^{-5}$ erg.

Thus, in nuclear physics, the loss of mass due to conversion into energy is definitely proved and measurable. This is due to the fact that in nuclear physics we are dealing with the forces in the nucleus of the atom and these forces are enormously greater than the forces which hold the external electrons in the atom. In the ordinary process of combustion, only the external electrons of the atoms are involved and the amount of energy released is so small, comparatively, that the accompanying loss of mass cannot be determined by any means within our grasp.

little that is known. As our knowledge increases our ability to satisfactorily operate this equipment efficiently and with the greatest degree of safety and reliability will increase until the disappointments of unscheduled outages and the loss of millions of dollars of fuel have been eliminated.

We are today on the threshold of a new and important age. An age of science in which our future steam generators will perhaps be operated on the principal of the release of heat by destruction of the atomic structure. The steam generator as we know it will probably be replaced by other methods of handling heat and energy sources but its contribution to world knowledge continues and we believe will continue for many years to come. The search for knowledge and understanding of heat and energy sources with which the steam generator has been so closely associated during the past will continue, leading to better ways of life for all humanity.

The Manufacture of Ice by Indirect Evaporation*

Direct evaporation compared to indirect . . . Heat transfer fluids . . . Freezing methods . . . "White ice" . . . Ice cracking, its causes and prevention.

By George Holman

THE first refrigeration equipment was designed, built and installed for the purpose of making ice by removing the latent heat of liquefaction from water. In turn, the ice so made was used to produce refrigeration by absorbing its heat of liquefaction from substances about it as it melted in ice boxes and other enclosed spaces. Although this ice was always made at temperatures below 32 F, it could produce refrigeration only at temperatures above 32 F, unless melting were forced by mixing salt or calcium chloride with the ice, as in home ice cream making. The melting of ice made for just that purpose was, and still is, an indirect method of cooling goods and keeping them cool.

Direct Evaporation vs. Indirect

In the early development of mechanical refrigeration, direct evaporation of the liquid refrigerant inside the spaces to be cooled was not resorted to, for various reasons. For household and small commercial refrigeration needs, the available equipment was much too cumbersome, and often troublesome and expensive as well. There was lack of accurate temperature controls. And ammonia, which was the only cheap and common refrigerant, was regarded as dangerous, detrimental to health, offensive to breathe even in very small quantities and likely to damage goods in storage.

Besides these factors there was the highly important one of economy in installation and operation. By installing a brine tank and small brine circulating pump it was possible to install a much smaller evaporator compressor and condenser for "jerk" loads, or loads which last but a part of the time. If refrigeration is needed but one-fourth to one-half of the time, as in milk plants and in some types of cold storages, a brine tank cooled by a small refrigeration system running full time could care for the load more efficiently than a much larger system operating intermittently.

Indirect evaporation is sometimes a matter of necessity. Although several methods of making ice by direct transfer of the heat of liquefaction from the water to the evaporating refrigerant have been developed, none of these as yet threatens to replace the old-fashioned method of setting cans of hygienic water into a tank of brine kept below 32 F by mechanical refrigeration, then withdrawing the heat from the brine by circulating it through or over an evaporator in which a refrigerant is boiling at a still lower temperature.

Heat Transfer Fluids

While oil, alcohol, or a number of other fluids with a low freezing temperature could be used to transfer heat from water to ammonia in an ice-making plant, these liquids are undesirable because of high cost, inflammability, high viscosity to interfere with circulation, likelihood of contaminating the ice, low heat carrying capacity, non-miscibility with water left clinging to the cans from the thawing tank or spray, etc. Due to its high heat carrying capacity, water is the best transfer liquid. Its main drawback is that it becomes solid at 32 F, the same temperature as inside the freezing cans.

To prevent water from freezing, quantities of calcium chloride and/or sodium chloride are dissolved in it. A brine so formed with 23 per cent sodium chloride (common salt) does not freeze until it is cooled to—6 F. This is the eutectic temperature. A 23 per cent solution of calcium chloride does not freeze until the temperature is lowered to —15 F, while the eutectic temperature is far below this point. Sodium chloride brine should never have a concentration greater than 23 per cent, since greater concentration raises the freezing point rapidly to 32 F. Calcium chloride, however, may contain a concentration of 30 per cent.

Both of these brines are widely used as the heat transfer fluid in ice making. Sodium chloride is generally cheaper, and carries the most heat per pound. At common ice making temperatures of 10 F to 15 F a sodium chloride brine will carry 7 per cent more heat than a calcium chloride brine having the same freezing point. Therefore pumping costs per ton of ice is greater for the calcium chloride brine.

However, calcium chloride brine is usually preferred over sodium chloride brine because it is less corrosive, more responsive to anti-corrosion treatment and because a lower suction pressure can be carried in the evaporator without danger of the brine sludging and stopping up the pipes or brine cooler tubes. Calcium chloride is not so susceptible to overconcentration. But it is for its greater neutrality toward the zinc coating of ice cans that it is preferred by managers and operators of ice plants.

In spite of more or less determined efforts to devise new methods, new technique and even new substances such as solidified carbon dioxide (dry

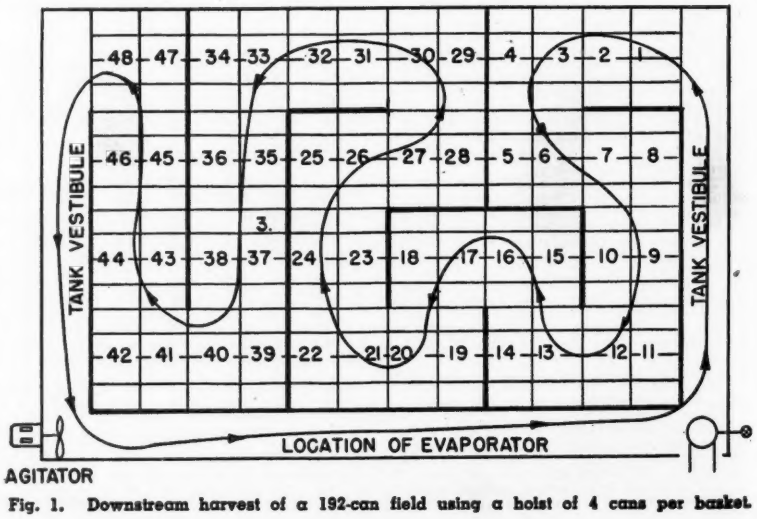

Fig. 1. Downstream harvest of a 192-can field using a hoist of 4 cans per basket.

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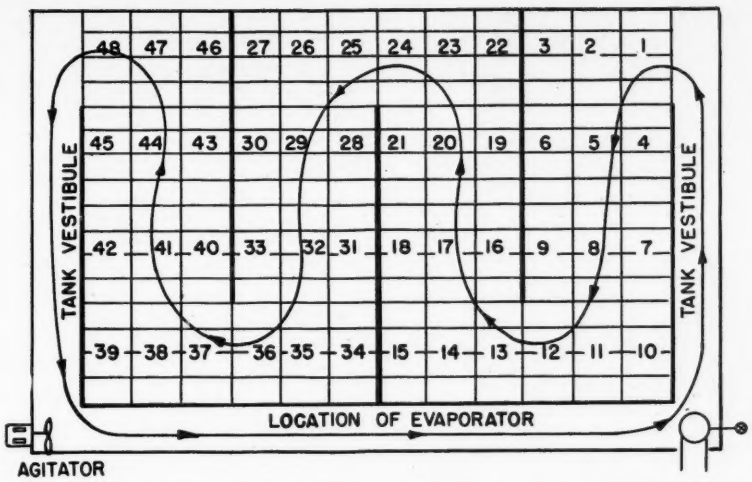


Fig. 2. Same field, same hoist, etc., but with baffles arranged to change course of brine.

ice), most commercial ice is still made in galvanized iron cans set into brine in a tank, just as it was made a generation ago. For every pound of flake ice, tubular ice, ice cubes, etc., made and sold, hundreds of pounds of ordinary bars of ice are made and sold.

However, one important change has taken place in the freezing method. A generation ago ice was made from water distilled by evaporating it in a boiler and condensing it in a condenser. It was reboiled in an open vat to remove any air in it. After cooling, it was led to the cans through a hose and attached "spider," the latter a float controlled valve used to fill the cans without agitating the distilled and reboiled water, from which the air has been removed. Any agitation permitted air to re-enter the water, and betray its presence by "white" ice.

On the other hand, almost all ice plants installed in recent years have been designed to use "raw" water, or water which has not been distilled or boiled. Instead of avoiding agitation as a means of keeping the air out of the water, continuous agitation of the water by means of compressed air is resorted to. Small air compressors similar to those used in garage work compress filtered air, and a system of pipes and hose carry it to the cans.

In the so-called "high pressure" agitation system, air at about 10 psi is led to the bottom of the can through a tube outside the can. In this system the compressed air must be dehumidified by previous passage over a coil of pipe through which very cold brine is pumped. The moisture of the air precipitates on the coils, and is drained off. Removal of the moisture is necessary to prevent it from freezing inside the tubes in contact with the brine in the tank. Such water could burst the tube. Generally, it merely stops the flow of air, and a bar of "white" ice is produced.

In low pressure air agitation systems the tube is swung into the center of the can from the top. Often it freezes into the bar of ice, and must be loosened with a steam or electric thawing needle before it can be removed and the bar of ice harvested.

"White Ice"

"White ice" is caused by some solid impurities in the water, but mostly by air dispersed as tiny globules in raw water and frozen into the ice. These tiny globules of air are just as invisible in the ice as in the water. It is not the globule of air which becomes visible on freezing, but only the walls of ice surrounding it and reflecting the light.

Air agitation clears out these tiny globules by washing them upward along the inward moving freezing surface of the ice. They escape to the atmosphere. As freezing proceeds, the agitation keeps the solid substances, always found in raw water, in solution in the diminishing quantity of core water. This core water becomes heavily concentrated. It must be pumped out and replaced with fresh water if white and/or "rotten" cores are to be avoided in the harvested bars.

Ice Cracking and Its Prevention

Any ice subjected to a sudden temperature change may crack badly. Distilled water is not so likely to crack as raw water. All cracking, however, depends upon the amount and kind of dissolved solids, amount

"It just came in the mail—it's supposed to be a year's supply of fuel for that new atomic powered engine in plant three."

of entrained air, rate of freezing, violence of agitation, temperature of the thawing water, temperature of the ice and the brine, presence of "green," or unfrozen spots in the top of each bar, uniformity of the thawing procedure, etc. Other things being equal, there will be less breakage if thawing is done in a dip tank, rather than under a spray.

Ice has two critical cracking temperatures, that at which it cracks under the thawing water; and that at which it cracks in the brine. When placed under 100 F water during harvesting, ice made from raw, unagitated water may crack if drawn from 20 F brine, or above. This same ice is almost certain to crack at 10 F in the field. Commercial anti-cracking compounds added to water may lower the cracking temperature two to five degrees.

If ice is given to cracking at the temperature of the brine necessary to capacity operation, the temperature of the thawing water should be lowered. If this slows the harvesting operation too greatly, hoisting should be carried out in downstream series, as shown in Figures 1 & 2. This depends upon the way the field is baffled. No matter how cold the water used to make ice, it is still several degrees warmer than the ice being harvested. Thus a basket of cans lowered into the tank anywhere will immediately begin to raise the temperature of the brine passing around them. The brine, in turn, will at once begin to raise the temperature of the cans containing ice immediately downstream. If this procedure is followed, much cracking of ice during the harvest will be prevented.

What Power Engineers Need to Know About

Rotameters

Principle of rotameters . . . Types . . . Rotameters in power plants . . . Accuracy . . . Alarm signals . . . Costs . . . How to select a rotameter . . . Precautions in installation and application . . . Temperature and pressure corrections . . . Advantages of the rotameter

A ROTAMETER is a simple flow measuring device which indicates at any time the rate of flow in the pipe line in which it is installed. It is used to show rates of flow of water, oil, gas, chemicals, etc., both liquid and gaseous, and gives direct readings in cubic feet, pounds, gallons, barrels or other units per hour or per minute.

Principle of Rotameter Is Simple

The principle on which the rotameter operates is simple. As shown in Fig. 1, the device consists simply of a vertical, transparent tube having a slightly tapered bore with the small end at the bottom. Inside the tube is a "top" shaped float, held in suspension by the upward flow of the fluid being metered. The float is entirely free and is caused to rotate rapidly by means of specially shaped slots cut in the head against which the fluid passing through the meter impinges.

Since the tube is tapered and the float is carried upward by increasing flow, the space through which the fluid must pass is in direct relation to the flow and the calibration is a straight line. So if a properly calibrated scale is either placed behind the transparent tube or etched in the glass, a reading can easily be obtained.

Types of Rotameters

Rotameters are manufactured for both horizontal and vertical pipes by several manufacturers. Figure 2 shows typical installations in both positions. There are several different types of floats, a few of which are shown here. Figure 3 shows the "top-shaped" or plumb-bob float, which is the most widely used and the guided float, essentially the same as the "top" except that it moves on a tension guide rod. Figure 4 shows the dashpot type designed to eliminate error due to pulsating flow.

Liquid flow rates as small as ½ cc per minute and air flow as low as 5 cc per minute can be measured by the rotameter. For large installations readings in thousands of gallons per minute and thousands of cubic feet per minute can be obtained.

Rotameters in Power Plants

During the war rotameters were installed on destroyers to measure the flow of water entering and leaving the evaporators, and since have been installed in stationary power stations for similar purposes. They have also been used to measure water entering and leaving chemical feedwater treatment apparatus.

Rotameters have not been very widely used for steam, since their accuracy depends on relatively constant conditions throughout the fluid being metered. To insure reasonable accuracy in measuring steam flow, the temperature, pressure, and quality of the steam must remain constant, which is hardly possible. Any condensation on the walls of the metering tube or on the rotor will cause inaccuracies in the readings. Changes in ambient temperature would affect the accuracy of a rotameter measuring steam since they would affect not only the condensation rate but also the temperature of the steam.

Wide Variety of Applications

The use of the rotameter is not limited to fluids of low viscosity; tars and pitches, heavy fuel oils, thick cold sulphuric oleum have all been successfully handled with this device. The meters can be used for high or low pressure conditions, each condition, of course, requiring a specially designed and constructed instrument.

Accuracy

Manufacturers claim rotameter accuracy within one per cent if the operator reads the millimeter scale correctly. If the scale is calibrated in millimeters, and it is necessary to refer to a curve for readings in terms of rates, an additional possibility of error is introduced. This can be eliminated by having the scale in the desired units etched right on the metering tube.

Manufacturing methods are accurate enough now so that the metering tubes are standardized and can be replaced without recalibrating the instrument. Rotors can also be replaced, specifying of course, the type, size, and material to be used.

Magnifying lenses placed over the scale facilitate accurate readings, and extra length scales are available to permit even further accuracy. A lucite disc placed in the rotor and a light placed behind the metering tube make it easier to read the scale when measuring opaque liquids. This inno-

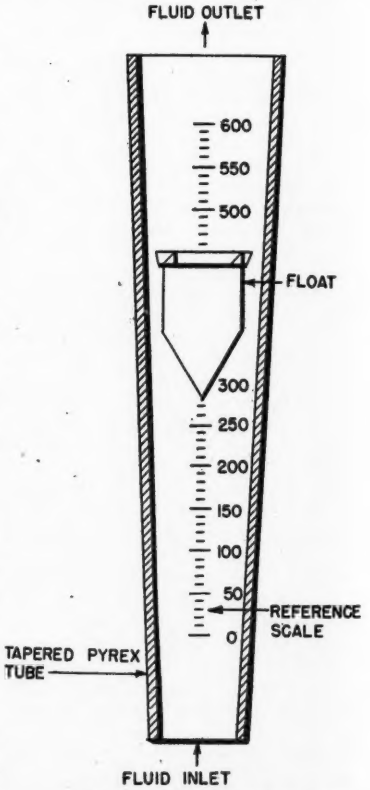


Fig. 1. Simple Rotameter

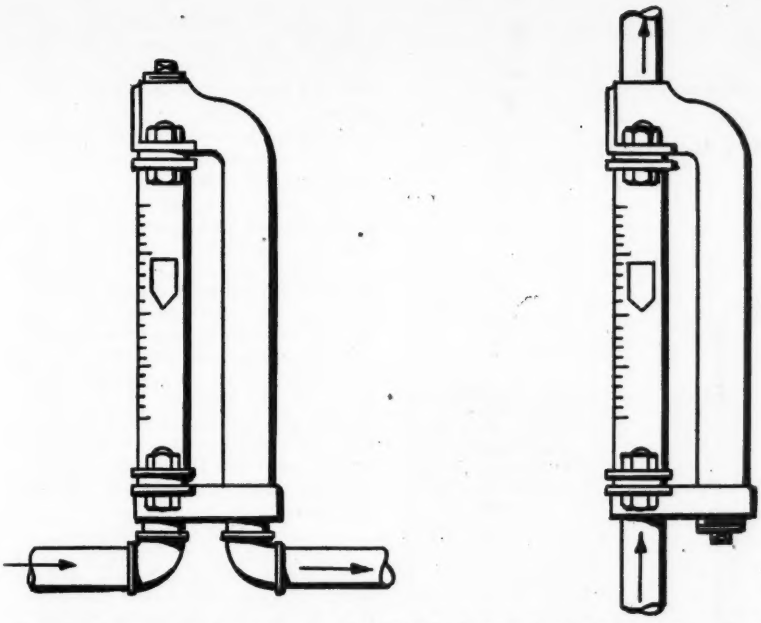


Fig. 2. Diagram showing rotameters installed in both horizontal (left) and vertical (right) pipelines

vation, called the "Line-O-Light Rotor," has been developed by Schutte & Koerting Co.

Alarm Signals

Photoelectric units have been added to the rotameters to provide alarm signals. They are designed so that a beam of light passes through the metering tube as long as the float remains below a predetermined level. When the float gets above this point the beam of light is broken and the photoelectric unit actuates an alarm system. It can also be arranged so that the alarm signal is given when flow reaches a predetermined low point. Other ways the float may be used to actuate an alarm signal are: by closing by contact an electric circuit, and by changing the impedance of an induction coil by a magnetic armature attached to the float.

From this brief explanation it is obvious that rotameters can be designed to meet a wide variety of conditions; so wide, in fact, that one manufacturer states that he has over a thousand different items in his application file.

Costs

Rotameters are less expensive than orifice meters for small sizes, but as the size increases the prices of the two become more equal until for large sizes the orifice meter is cheaper. After a certain point the price and size of orifice meter auxiliaries becomes more or less constant, and the price increase after that depends only upon increased costs of the orifice. Rotameters, however, have no such leveling-off point, since increased size means increased cost, because all parts have to be larger.

How to Select a Rotameter

The capacity of a given size rotameter is governed largely by the diameter of the tapered tube, although it may be increased by using a heavier float. The weight of the float may be increased by using a metal of greater density or by increasing the size of the float within limits determined by the need for stability of float behavior.

The manufacturers list rotameter liquid capacities in terms of water, so in order to use their tables it is necessary to convert into terms of water. Cochrane Corp. recommends the following equation:

$$\text{Equivalent water capacity} = \text{Capacity of liquid to be measured} \times \sqrt{\frac{6.92 \times \text{Sp Gr of liquid}}{7.92 - \text{Sp Gr of liquid}}}$$

Gas capacities are in terms of air at standard conditions of atmospheric pressure 14.7 psia and 70 F. To convert other gases to air equivalent the following equation can be used:

$$\text{Equivalent air capacity} = \text{CFM of gas} \times \sqrt{\text{Sp Gr of gas}}$$

Once the capacity has been expressed in terms of air the conversion to conditions other than standard is performed by using the following equations:

For pressure correction multiply by

$$\sqrt{\frac{14.7}{\text{Operating pressure in psia}}}$$

For Fahrenheit temperature correction multiply by

$$\sqrt{\frac{\text{Absolute temp in deg F}}{530}}$$

For Centigrade temperature correction multiply by

$$\sqrt{\frac{\text{Absolute temp in deg C}}{273}}$$

What Pressure Drop?

At times it is important to reduce the pressure drop through a rotameter to a minimum. The pressure loss equals the weight of the float (a constant) plus friction losses through the end fittings which vary with the rate of flow. An oversize rotameter will reduce the pressure losses because the same amount of flow can be measured with a lighter float. It is necessary in such cases to use a guided float, because the abnormally light float would otherwise oscillate. When selecting a rotameter the manufacturer should be instructed as to the allowable pressure drop.

What Length Scale?

Obviously, greater scale length permits more accurate reading, but the lengths usually are standardized by the individual manufacturers. Cochrane uses scales 6 in. long for all sizes having ⅛ in. connections, scales 10 in. long for instruments having connections from ¼ to 2 in. and larger. An extra length scale 25 in. long is made for installations requiring greater accuracy.

What Material?

The corrosive properties of the fluid to be measured determines the nature of the metal used for the fittings. End fittings for normal service are usually made of brass. Steel and stainless steel are used for special services and the various other corrosion resistant metals, hard rubber and other materials are used for especially corrosive fluids. Brass is the standard material for the tube case and milled rings, since these parts do not come in contact with the fluid. Corrosive atmospheres, however, may necessitate the use of steel for these parts.

The float is virtually the meter itself, and no corrosion of the float can be tolerated for any change in its pre-

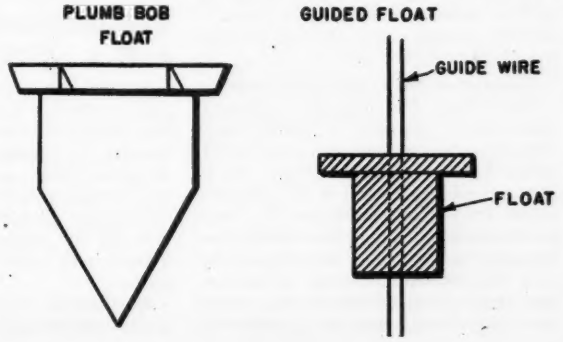


Fig. 3. Two types of floats

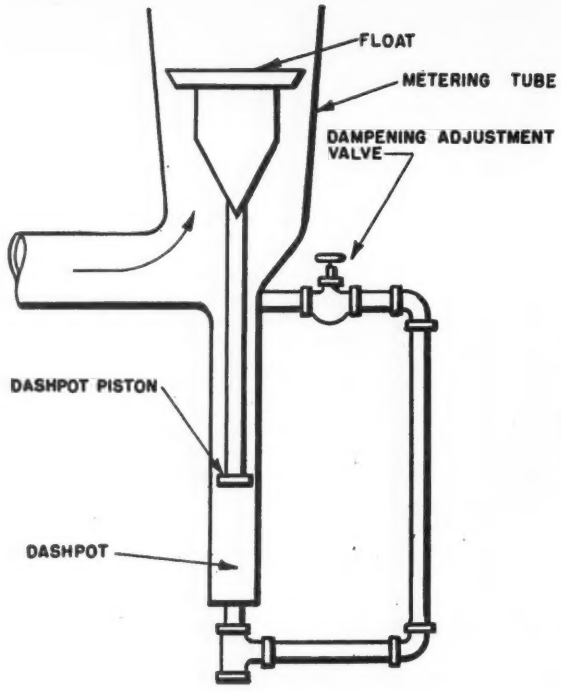


Fig. 4. Schematic diagram (not to scale) of dashpot-type rotameters for eliminating errors caused by pulsating flow

cise dimensions causes resultant inaccuracies in the readings. Floats have been made from a wide variety of materials, including the precious metals, since this part is small enough so that costs do not become prohibitive. Among materials used for floats are gold, silver, platinum, lead, tantalum, Durion, Hastelloy, porcelain, glass, lava, and rubber. It is not unlikely that various plastics may be used in the future, as well as new alloys.

Precautions in Installation and Application

The rotameter must be installed so that the transparent tube is exactly vertical; any variance causes inexact readings. The inlet is always at the bottom and the outlet at the top or bottom depending on the arrangement of the connections. (See Fig. 2) The pipe line should have some provision for expansion and contraction in order to avoid distortion of the instrument.

Because of the nature of the float within the tube, control valves must be opened and closed gradually so that sudden changes in flow will not damage the float by causing it to strike the stops sharply. Similarly, caution must be exercised to prevent sudden temperature changes which would damage the glass.

Temperature and Pressure Corrections

Correction of readings for ordinary temperature changes is unnecessary except in laboratory research work. When handling gases the float readings must be corrected if the pressure varies from that for which the scale is calibrated. When the variations in pressure are small the corrections may be neglected. Tables of correction factors can be supplied to facilitate corrections when the pressure variations are sufficient to warrant them.

Grease or dirt that collects in the tube can usually be removed by flushing the rotameter with clear water or disconnecting the tube and washing it in a cleaning solution.

Advantages of the Rotameter

The outstanding advantage of rotameters is their linear calibration with uniform spacing between graduations throughout the entire length of the scale facilitating easy reading, whereas the space between graduations of a squart root scale diminishes as the lower end of the scale is approached, and reading becomes increasingly difficult.

Pressure losses through the rotameter are small, and since loss due to the rotor does not change, they are nearly constant. Other advantages which have been mentioned previously are economy in smaller sizes, interchangeability of metering tubes and floats, visual indication of flow, and ease of cleaning.

Decameron Tales, Mechanized Version

By W. E. PATTEN

EVERY DAY we encounter many people who go about without having the slightest knowledge or comprehension of machinery that they use or abuse daily, such as our neighbor who jumps into his car that has been sitting out all night in zero weather, revs up the engine to 5,000 or there abouts, and takes off like a pursuit plane.

To those of us who have lived with gages and nursed machinery most of our lives, it seems incredible that many of these have-nots in the field of mechanical knowledge manage to live to a ripe old age in spite of themselves.

We were greatly amused recently at the excitement of a fireman of a low pressure boiler.

The engineer had replaced the steam gage which had been of the 0-15 lb, retard 30 lb variety. The new gage had a 0-30 lb scale with equally divided calibrations. The result was that 15 lb on the new gage was at 12 o'clock compared to the 3 o'clock position on the old one. It took three days to convince "Mac" why, as he expressed it, his boiler popped off with half a head of steam ever since the new gage was put on. In his mind the steam gage wagged the boiler just as the tail would wag the dog.

Cold Turkey

A few days before Thanksgiving, a meat buyer called the cold storage plant to leave orders for Room No. 6 to be set for 42 deg to receive a carload of turkeys.

The day after the turkeys arrived, the plant telephone started sputtering with the buyer on the other end wanting to know just who at the plant was disobeying orders because he had just come from Room No. 6 and where the temperature was 22 deg and the turkeys were still frozen hard and beyond all hope of being drawn.

What this man had not mentioned before was that these turkeys arrived at a temperature of 10 deg, yet he firmly believed that the thermostatic control, by some process of magic, could impart the necessary Btu's to fetch this carload hunk of frozen meat up to his specified 42 deg in spite of insulation, specific heat, and all the rest of the factors we spent the midnight oil to learn about.

Cold Meat

Butchers in retail meat stores have their problems with reverse heat flow also.

We will say, for instance, that this butcher hits the jack pot and buys six quarters of beef. His walk-in cooler will hold only two, so he sends the other four to the local freezer.

Every one else is having meat frozen these days, so the idea sounds good to him too.

All goes well until one of those quarters at 0 deg is shipped back and is placed in the store cooler. Shortly thereafter the butcher calls his refrigeration service man with the complaint that his meat is slimy and his compressor don't run.

The service man finds the temperature OK at 35 deg in the box, the machine OK, but the meat dripping wet. The next move is to stick a knife into that sweating quarter and insert a thermometer. Four inches below the surface the temperature is 20 deg.

Who needs a refrigerating machine when the meat itself will cool the box?

Boosting the Thermostat

The heating system repair boys get their share of screw-ball public reactions along with the rest.

On being called on a "no heat" call, one repairman found the heating thermostat permanently damaged by the owner holding a lighted candle under it. The owner believed that if he could get the thermostat warmed up, that the building would get warm also, something like the process of applying the spur to the horse.

Where angels fear to tread

Once upon a time, there was a maiden lady who occupied an apartment over a store that had for its refrigerating plant an old 4 by 4 in. double ammonia compressor. The old girl set up a steady beefing about this machine keeping her awake nights by its noise.

Suddenly the beefing stopped, but so did the refrigeration system stop every night. She had access to the cellar where the water service valve was located, and some kind friend had told her that if she shut the water off, the machine would stop.

In spite of the fact that the machine had an old dial type high pressure cut out with sector contacts, the motor stopped faithfully every time the head pressure reached 250 lb or when the compressor started flapping up and down on its base. Either means would trip the safety.

All the while our self appointed female engineer slept peacefully right above that pair of cylinder heads that every half hour were trying to take flight and carry her into the great beyond.

Ignoring all warnings, she kept right on shutting off the water, and only when a separate water service was installed, did she take flight of her own accord and move to other quarters.

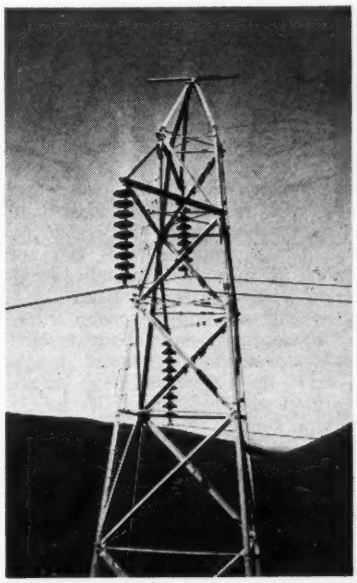
Eagle Roosts for Transmission Towers

By Gilson V. Willets

IN THE HIGH SIERRAS huge hydroelectric plants produce power for California's coastal cities. In past years this service was frequently interrupted because of birds which came to roost on towers which carried high voltage lines. When large birds, such as eagles, hawks and pelicans, attempted to "take off" from these towers, their wing tips occasionally touched two of the wires. Such contact would be followed by a blinding flash after which a cooked bird would fall in a shower of feathers and smoke while miles away entire cities and communities would be without light or power until damage caused by the resulting short circuit could be repaired.

Some time ago an attempt was made to overcome this annoyance by installing ten-foot ¾-in. steel pipes to be used as roosts on the high power transmission line towers. These were satisfactory to smaller birds but were shunned by eagles and other large birds whose claws could not obtain a suitable grip on the small steel pipe. Electrocutions and interruptions to service continued.

The problem has now been solved by a power company which has replaced the steel perches with *wooden bars two inches thick.* In the photograph note an "Eagle's Roost" atop a Pacific Gas & Electric Company's transmission line tower in the treeless district between Tracy and Livermore, California. This wooden perch is popular with large birds and it is far enough above high voltage lines to give large birds an opportunity to spread their wings in flight before they drop to a point where wing tips might make contact with the wires.



High voltage transmission tower between Tracy and Livermore, Cal. Note the eagle's roost on the top of this tower. Photo, Pacific Gas & Electric Co.

Voltage Loss of D-C Generator

By John F. Slavinsky

AFTER MONTHS of trouble free service from our steam engine, we decided to give the old girl a treat. She was getting kind of noisy so we made adjustments on the cross-head, crank, bearings, etc.

The usual procedure in our plant after making any adjustments of this sort is to gradually get the engine up to speed and keep a close watch on the parts that were "taken" up. After running the engine for about an hour at full speed we make an inspection and if the temperature is not excessive on the adjusted parts we then put an O.K. on the job.

This particular engine drives a 1000-amp, 250-v, d-c generator. After getting the engine up to speed, much to our surprise we saw that the voltmeter only registered 10 volts. The first thing we did was to move the rheostat to cut out the resistance but the voltage remained at 10 volts. We then shut down the engine; we inspected the generator for loose or broken connections, and everything seemed to be O.K. Checked the brushes and "rang" out the rheostat itself to see if there were any open connections. Then we started the engine and brought it up to speed; still the voltmeter registered 10 volts. Well, we thought, perhaps the meter was at fault so we checked the meter with a portable hand meter and the both meters were in complete agreement. After checking the polarity it was found to be of proper sign.

We then decided to start up one motor generator which has the same characteristics as the engine-driven generator. We put the motor generator on the d-c bus, with 230 v showing on the voltmeter we put in the engine generator breaker.

We threw in the first breaker and the current pumped back into the engine generator. Of course, we only had the breaker in for a second, but the slight kick it received from the motor-generator started the excitation of the generator fields and the voltage built right up to where we wanted it. Whether we did the right thing by doing this operation will probably create some discussion among the other engineers, but in our case we did get the voltage up.

We still did not know what the trouble was. After running the unit a week without any apparent trouble we shut the machine down over the weekend. On Monday morning the same thing happened all over again; the generator voltage would not build up.

We were getting ready to try out the stunt that had proved so effective the week before when, very slowly, the voltage came up of its own accord. After making a more thorough check up of the generator connections we found one of the wires of the shunt field to be very hot. So we shut down again and investigated this hot wire and found that the solder in the terminal lug had broken loose, though from outward appearance, it seemed to be tight. Actually it was making a very poor connection. After soldering a new terminal to the lead we had no further trouble with the unit. It built up to full voltage without any trouble.

The Boiler Fireman's Handbook

By J. R. DARNELL

Description of Various Types of FW Heaters . . . Open Heaters . . . Closed Heaters . . . Economizers, Their Function and Location in the Boiler . . . Maintenance of Economizer Surfaces . . . How to Figure Fuel Savings

Part XXII—Heating Feedwater

SINCE THE use of preheated feedwater in boiler operation is an important factor in saving fuel, all boiler firemen should be familiar with the care and operation of those auxiliaries which may be employed to accomplish such results.

Boiler feedwater may be heated either by exhaust steam or waste gases. In some cases stage heating with extraction steam is employed but is seldom used in small plants.

When using exhaust steam either open or closed types of heater may be used.

Open Heaters

As shown by Fig. 1 an open feedwater heater consists of a chamber in which the water directly contacts the steam. It has one advantage over the closed type in saving condensed steam as feedwater. When properly operated, feedwater heaters of this type will heat the water to about 210 F. Open heaters may be either of the vertical or horizontal type. Figure 1 shows the vertical type while Fig. 2 is an example of the horizontal type.

Since gases such as oxygen and carbon dioxide may be dissolved in the water and therefore, cause serious corrosion trouble, the deaerating type open heater is often used to eliminate these gases. As shown by Fig. 3, the water in this type of heater is admitted through spray nozzles and is heated to about 215 F by exhaust steam. The steam entering the heater atomizes the water and thereby produces such thorough agitation of the water that all gases are liberated and pass from the heater through vents.

Closed Heaters

Figure 4 shows a closed type of feedwater heater. Such heaters may be arranged either horizontally or vertically. Closed heaters are used where the water is to be heated under pressure and without direct contact with the steam. With the proper amount of heating surface in the closed type of heater, the water can be heated to within 15 deg of exhaust steam temperature.

Economizers

An economizer, similar in construction to a boiler, comprises an arrangement of tubes and headers, through which water is passed, usually in counter current flow to waste gases. To avoid internal corrosion, water fed to an economizer should first pass through a deaerating heater.

In Fig. 5 is shown a cross sectional view of the arrangement of tubes and headers in an economizer provided with extended surface to obtain greater heat absorption. This extended surface is made up of cast iron rings cast in groups of nine. These castings are shrunk on to steel tubes and thus provide six times the external heat absorbing surface of the bare tubes. Some economizers are used only with plain tubes but the arrangement of tubes and headers is similar to that shown in Fig. 5.

Theoretically at least, there is no fixed limit to the temperature to which water can be heated in a properly designed economizer. In practical operation, however, the limit of temperature is dependent on such factors as the operating pressure of the boiler, the temperature of the heating gases, the area of heating surface employed and the rate of heat transfer. There is always, of course, an optimum and economical size of economizer for given operating conditions. Space does not permit any discussion of the procedure involved in selecting the most economical size.

To obtain the best results in economizer operation the temperature of the entering water should be 200 F or higher, the water having been raised to such temperature by a deaerating type of steam heater. This

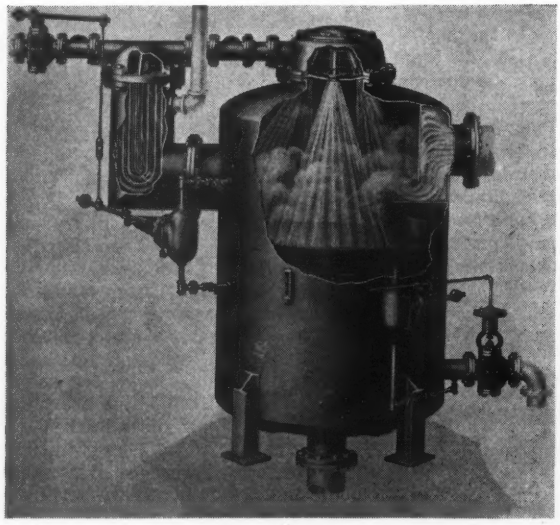


Fig. 1. Spray-type open heater arranged vertically

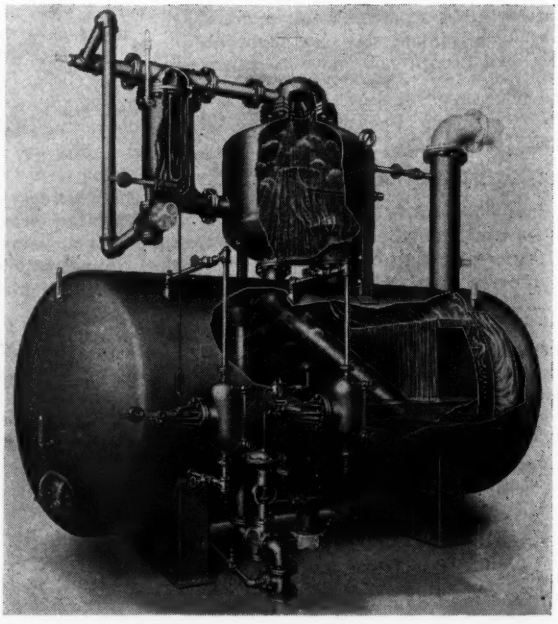


Fig. 2. Spray-type deaerating open heater arranged horizontally

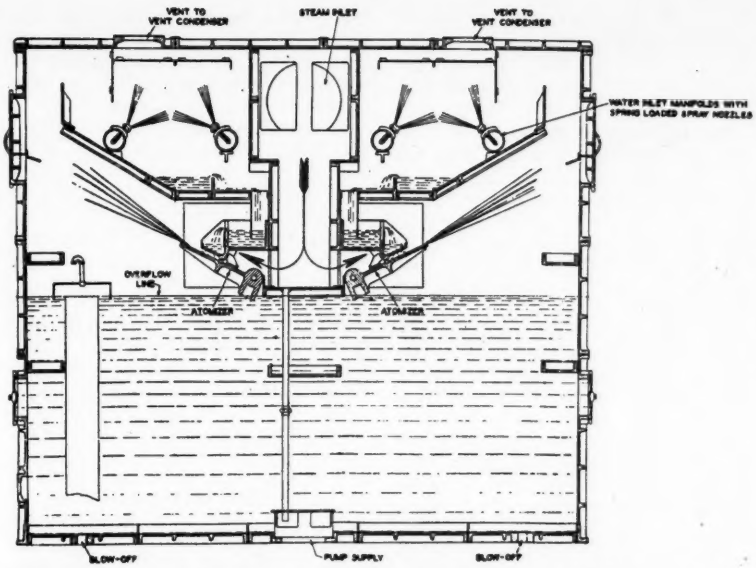


Fig. 3. This is a deaerating type of open heater. Water is admitted through spray nozzles

formance of different boilers or various performances of the same boiler.

This standard is known as "equivalent evaporation" since it makes all boiler operations appear as if the water is introduced at a temperature of 212 F and evaporated at this same temperature. Such condition in boiler efficiency calculations is expressed by the term "from and at 212 degrees."

Actually, the feedwater temperature at one time may be 150 F, the boiler pressure 200 psi and at another time the feedwater temperature may be 250 F and the boiler pressure 300 psi. To resolve all of these variables to a common basis, a calculation must be made to determine the "factor of evaporation" as follows:

$$\text{Factor} = \frac{H - h}{970.2}$$

where H = total heat in steam above 32 F

h = sensible heat of feedwater above 32 F

To find the saving effected by increasing the temperature of the feedwater the following formula may be used:

Fuel saving, per cent

$$\frac{t - t_1}{(H + 32) - t_1}$$

where t = temperature of water after heating

t_1 = temperature of water before heating

H = total heat of saturated steam above 32 F, absolute pressure

In Table 1, columns A and B, is shown an assumed performance of an

will prevent internal corrosion while external corrosion can be largely prevented by selecting an economizer having an area of heating surface and rate of heat transfer not in excess of that which will reduce the temperature of the exit gases below the dew point. This will vary, of course, depending upon operating conditions, but may be of the order of 175 to 190 F.

To keep the external surface clean, the economizer should be provided with mechanical type soot blowers which should be used at least once each 8 hour shift.

TABLE I

Item No.	Description	A	B
1	Heat value of fuel, Btu per lb	18700	18700
2	Boiler pressure, psig	135	135
3	Feedwater temperature, deg F	160	210
4	Total heat in steam above 32 deg, Btu	1225.5	1225.5
5	Factor of evaporation	1.13	1.08
6	Apparent evaporation, lb per lb fuel	13.0	13.6
7	Equivalent evaporation, lb per lb fuel	14.7	14.7
8	Efficiency, per cent	76.3	76.3

How to Figure Fuel Saving

Increasing the temperature of the boiler feedwater, either by open or closed heaters using exhaust steam will save approximately one per cent for each ten degrees increase in temperature. Adding heat to the feedwater, however, will not increase the overall boiler efficiency except in the case of the economizer where the temperature of the exit gases is reduced and consequently the heat lost in these gases will be reduced.

Some operators may argue that since raising the feedwater temperature gives the boiler less work to do and consequently uses less fuel to do the same amount of work, the efficiency must be increased. But although by the term "efficiency" we mean the ratio of the heat energy put into that taken out, in figuring boiler efficiency all variable conditions must be reduced to one standard either when comparing the per-

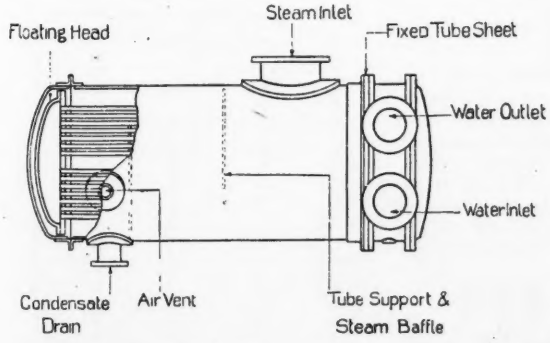


Fig. 4. In this closed type of heater, arranged horizontally, the water passes through tubes with the steam in the shell surrounding the tubes

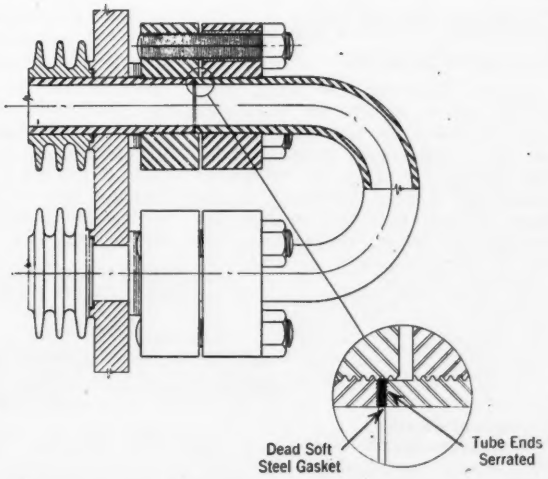


Fig. 5. In this extended surface economizer the tubes are covered with cast iron rings which provide six times more heating surface than plain tubes

oil fired boiler with all conditions the same except for different conditions of feedwater temperature and the apparent evaporation. In column A the feedwater is 160 F and in B it is 210 F.

In column A the apparent evaporation is 13 lb of water for each pound of fuel oil used but in column B it is increased to 13.6 lb. This is due to the fact that the increase in feedwater temperature from a source of heat which otherwise would be lost, will cause more pounds of water to be evaporated per pound of fuel burned. Since, as shown in column A, one pound of fuel oil will evaporate 13 lb of water with 160 F feedwater temperature, then with 4.1 per cent fuel saving as calculated by the formulas, 1.000 — 0.041, or 0.959 lb of fuel will evaporate the same amount of water when the feedwater temperature is raised to 210 deg F. Under these conditions, one pound of fuel will evaporate 13.6 lb of water instead of 13.0 lb.

Although the apparent evaporation is higher in column B than in A, the equivalent evaporation is the same in both cases since the factor of evaporation is lower in B than A. This is due to the fact that with the higher temperature of the feedwater shown in B, conditions more nearly approach the standard of "from and at 212 F."

Having obtained figures for the apparent evaporation in each case, we next proceed in the orthodox manner to find the efficiency. Multiplying the equivalent evaporation by the latent heat of vaporization of water (970.2 Btu*) and dividing by the heat value of the fuel we obtain 76.3 per cent efficiency for both columns A and B.

The higher apparent evaporation, as shown in column B, is the important item in considering fuel saving but is not, in any way, an indication of efficiency. Since the equivalent evaporation is the same in both cases the efficiency must be the same in spite of the fact that 4.1 per cent less fuel is used in one case than in the other.

Although many find it hard to understand, the fact remains that increasing feedwater temperature saves fuel but does not and can not increase efficiency when heating with exhaust steam.

*See Keenan's Steam Tables.

LETTERS AND COMMENTS

Taking Coal Pile Temperatures

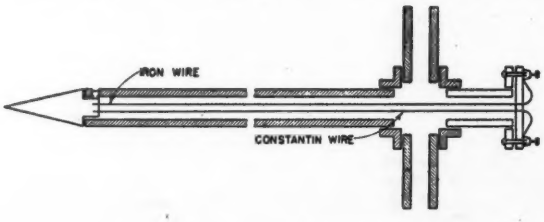
IN THE FEBRUARY 1946 issue, page 95, an article by Charles W. Parks appears under the above title. This and other articles are grouped under the general heading of "Practical Hints and Kinks." However, it appears to me that the method described for taking the temperature below the surface of a coal pile is anything but practical.

The critical temperatures of hot spots in coal piles are in the order of 150-170 F. An indicating thermometer of the pencil type is entirely unsuitable for such work, particularly if the hot spot is 5 to 10 ft below the surface. If the thermometer is lowered inside of a pipe as the author suggests and actually reads 170 F at a point 6 ft down, by the time the operator can draw it to the surface and get his eye focused on the mercury column, the latter may have dropped 20 to 25 deg.

In Part VI of The Boiler Fireman's Handbook, page 102, January, 1945, issue I describe a practical method of detecting hot spots in a coal pile by means of a thermocouple. This portion of Part VI reads as follows:

"By using an especially designed thermocouple, connected to a potentiometer or galvanometer the temperature of a coal pile can be systematically checked and "hot spots" detected. Such a thermocouple can be easily made by peening thermocouple wires (iron and constantan or copper and constantan) into a cone-shaped plug which is fitted into one end of a piece of ½ in. pipe, 12 to 15 ft long. This cone-shaped plug is held in place by an Allen set screw. Inside of the pipe the wires are threaded through glass or porcelain tubing or one of the wires may be wrapped with tape and each connected to binding posts bolted through fiber disks, one of which is screwed onto a ½ in. pipe nipple connected to a cross-tee just back of this. This cross tee is provided in order that short pieces of pipe 8 to 10 in. long may be screwed into the sides of the cross for use as handles. These handles facilitate the insertion and removal of the thermocouple at various points in the coal pile. Figure 1 shows a longitudinal cross section of this thermocouple."

Naperville, Ill. J. R. DARNELL.



Thermocouple made from ½-in. pipe and fittings

More on the 40-hr Work Schedule

AFTER CAREFUL study of Charles W. Parks' 40-hour work schedule appearing in the March issue of Power Plant Engineering, it seems to me that it is not a 40-hour schedule but a 42-hour schedule.

E. E. Wilson's 42-hour work schedule

7 - 3	3 - 11	11 - 7	Off	Day
B	C	A	D	S
B	C	A	D	M
B	D	A	C	T
C	D	A	B	W
C	D	A	B	T
C	D	B	A	F
C	D	B	A	S
C	D	B	A	S
C	D	B	A	M
C	D	A	B	B	D	C	T
D	A	A	B	B	C	C	W
D	A	A	B	B	C	C	T
D	A	A	B	C	C	B	F
D	A	A	C	C	B	B	S
D	A	A	C	C	B	B	S
D	A	B	B	C	C	B	A	M
A	A	B	B	C	C	D	D	T
A	A	B	B	C	C	D	C	W
A	A	B	B	D	D	C	C	T
A	A	B	B	D	D	C	C	F
A	A	B	C	C	D	D	C	S
A	A	B	C	C	D	D	B	S
A	B	B	C	C	D	D	A	M
B	B	C	C	D	D	A	A	T
B	B	C	C	D	A	A	D	W
B	C	C	A	A	D	D	D	T

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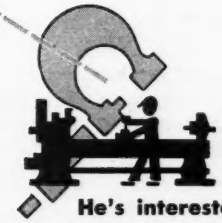

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I would like to submit for your or Mr. Parks' consideration a schedule which I think would accomplish the same purpose, and at the same time, give the men more time off.

Port Neches, Texas. E. E. Wilson

I WOULD like to comment on the article "A 5-Day, 40-Hour Work Schedule," by Chas. W. Parks, on page 106 of the March issue of POWER PLANT ENGINEERING.

The schedule is misleading and it would not work in my company where men are paid overtime for all time over 40 hours per week. Take for instance the week from Sunday, January 6th through Saturday, January 12th. During this time "A" works six days; "B" works 6 days; "C" works 5 days and "D" works four days. The

Avant's 5 Day, 40 Hour Work Schedule

	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	
1st Week								
11- 7	A	A	B	B	B	B	B	A—6 Days
7- 3	C	C	A	A	C	C	C	B—5 Days
3-11	D	D	D	D	D	A	A	C—5 Days
								D—5 Days
2nd Week								
11- 7	B	B	C	C	C	C	C	A—5 Days
7- 3	D	D	B	B	D	D	D	B—6 Days
3-11	A	A	A	A	A	B	B	D—5 Days
								D—5 Days
3rd Week								
11- 7	C	C	D	D	D	D	D	A—5 Days
7- 3	A	A	C	C	A	A	A	B—5 Days
3-11	B	B	B	B	B	C	C	C—6 Days
								D—5 Days
4th Week								
11- 7	D	D	A	A	A	A	A	A—5 Days
7- 3	B	B	D	D	B	B	B	B—5 Days
3-11	C	C	C	C	C	D	D	C—5 Days
								D—5 Days
5th Week								
Same as First Week								
11- 7	A	A	B	B	B	B	B	A—6 Days
7- 3	C	C	A	A	C	C	C	B—5 Days
3-11	D	D	D	D	D	A	A	C—5 Days
								D—5 Days

schedule could be arranged so that it would be necessary to pay only one man for one day extra, each week. With my schedule the short change is eliminated.

You will note in the accompanying schedule that the men change shift without doubling back. We run our shifts thus No. 1—11 pm-7 am; No. 2—7 am-3 pm; No. 3—3 pm-11 pm. Also that the man who is working the 11-7 shift is on the relief shift the following week. After the fourth week the fifth week is the same as the first week. This schedule revolves around and around throughout the year.

Wilmington, N. C.

G. G. AVANT

IN THE March issue of the POWER PLANT ENGINEERING, Mr. Chas. W. Parks submitted a 5 day—40 hour work schedule. I think if he will check his schedule, he will find he has a 42 hour work schedule.

Referring to Mr. Park's schedule in the March issue:

A, B, C, and D work 7 days of 7-3, 7 days of 3-11 and 7 days of 11-3 with only 7 days off in 4 weeks. In 4 weeks there are 84 shifts to be taken care of, each man can only take care of 20 shifts (in order to maintain a 40 hour week), therefore one extra day must be taken care of each week when employing only 4 men on the schedule.

I am enclosing a schedule similar to Mr. Parks, but I believe it has some advantages, there are no quick changes. Of course a substitute must be found for the Thursday 7-3 shift (shown in bold face on enclosed schedule) or this will also be a 42 hour schedule.

Vallejo, Calif. KEITH KIMBALL.

Kimball's Work Schedule

	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
12-8..	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4	4	1	1
8-4..	2	2	2	**2**	3	3	3	3	**3**	**3**	**3**	**4**	**4**	4	4	4	4	4	1	1	1	1	1	1	1	2	2	2
4-12..	3	3	4	4	4	4	4	4	4	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3
Off..	4	4	3	3	2	1	1	1	1	1	4	4	3	2	2	2	2	1	1	4	3	3	3	3	2	2	1	4	4

Questions And Answers

Question No. 335

Self-Instruction in Mathematics and Physics

PLEASE SEND me a list of good modern text books, of a rather elementary kind, suitable for self-instruction in mathematics, physics and logic.

Vienna, Austria F. K.

ENGINEERS are always asking us about books of this type, and this seems an appropriate time to list some that we frequently recommend for this purpose. There are, of course, many others, which may be just as good or even better. These are some we know first hand, as reported to F. K.

1. **Practical Mathematics,** Published by the American Technical Society, 58th and Drexel, Chicago, Illinois. Price $2.50.
2. **Plane Trigonometry Made Plain,** Published by the American Technical Society, 58th and Drexel, Chicago, Illinois. Price $2.75.
3. **The Slide Rule Simplified,** Published by the American Technical Society, 58th and Drexel, Chicago, Illinois. Price $2.50.
4. **Basic Mathematics for Engineers,** by Paul G. Andres, Hugh J. Miser and Haim Reingold, Published by John Wiley and Sons, 440 Fourth Avenue, New York 16, New York. Price $4.00.
5. **Calculus Made Easy,** by Silvanus Phillips Thompson, The Macmillan Co., 60 Fifth Avenue, New York, N. Y. Price $2.00. 1924.
6. **General Physics,** by Oswald Hance Blackwood, John Wiley and Sons, 440 Fourth Avenue, New York 16, New York. Price $3.75. 1937.
7. **From Galileo to Cosmic Rays,** by Harvey Lemmon, University of Chicago Press, Chicago, Illinois. Price $3.75.
8. **Practical Heat; also Practical Electricity,** both by Terrell Croft, McGraw-Hill Book Co., 330 West 42nd Street, New York, N. Y. Price $5.00 each.
9. **Atomic Physics,** by O. H. Blackwood and the Physics Staff of the University of Pittsburgh, John Wiley and Sons, 440 Fourth Avenue, New York 16, New York. Price $3.75.
10. **The Philosophy of Physics,** by Max Planck, Allen and Unwin, London.
11. **Tre New Universe,** By Baker Brownell, D. Van Nostrand, 250 Fourth Avenue, New York 3, New York. 1926.
12. **The Universe Around Us,** by James Jeans, The Macmillan Company, 60 Fifth Avenue, New York, New York. Price $3.75.
13. **The Nature of the Physical World,** by Sir Arthur Stanley Eddington, 1927, The Macmillan Company, 60 Fifth Avenue, New York, New York.
14. **Our Knowledge of the External World.** Scientific Method in Philosophy, by Bertrand Russell, The Open Court Publishing Co., London.

Mathematics books 1 and 2 in the above list are written simply and clearly for the beginner, starting with arithmetic and going through elementary algebra and geometry, with good explanation of logarithms. Basic Mathematics for Engineers, No. 4, is a bit more advanced, beginning with the fundamentals of algebra, then treating trigonometry, graphs, vectors, exponents and radicals, and logarithms, all from the point of view of the engineer. The remainder of the book discusses in a little more detail such things as the oblique triangle, the J operator, quadratic equations, the equations of lines, circles and conic sections and ends with the fundamental principles of the calculus. Most engineers will find in this book practically all the mathematics they need for everyday work outside certain design fields. Calculus Made Easy is just that—any 18-year old boy should be able to understand this book.

In physics, we suggest starting with either No. 6, Blackwood's General Physics or No. 7. The latter is written and illustrated in a little

All Drip and Drain Piping
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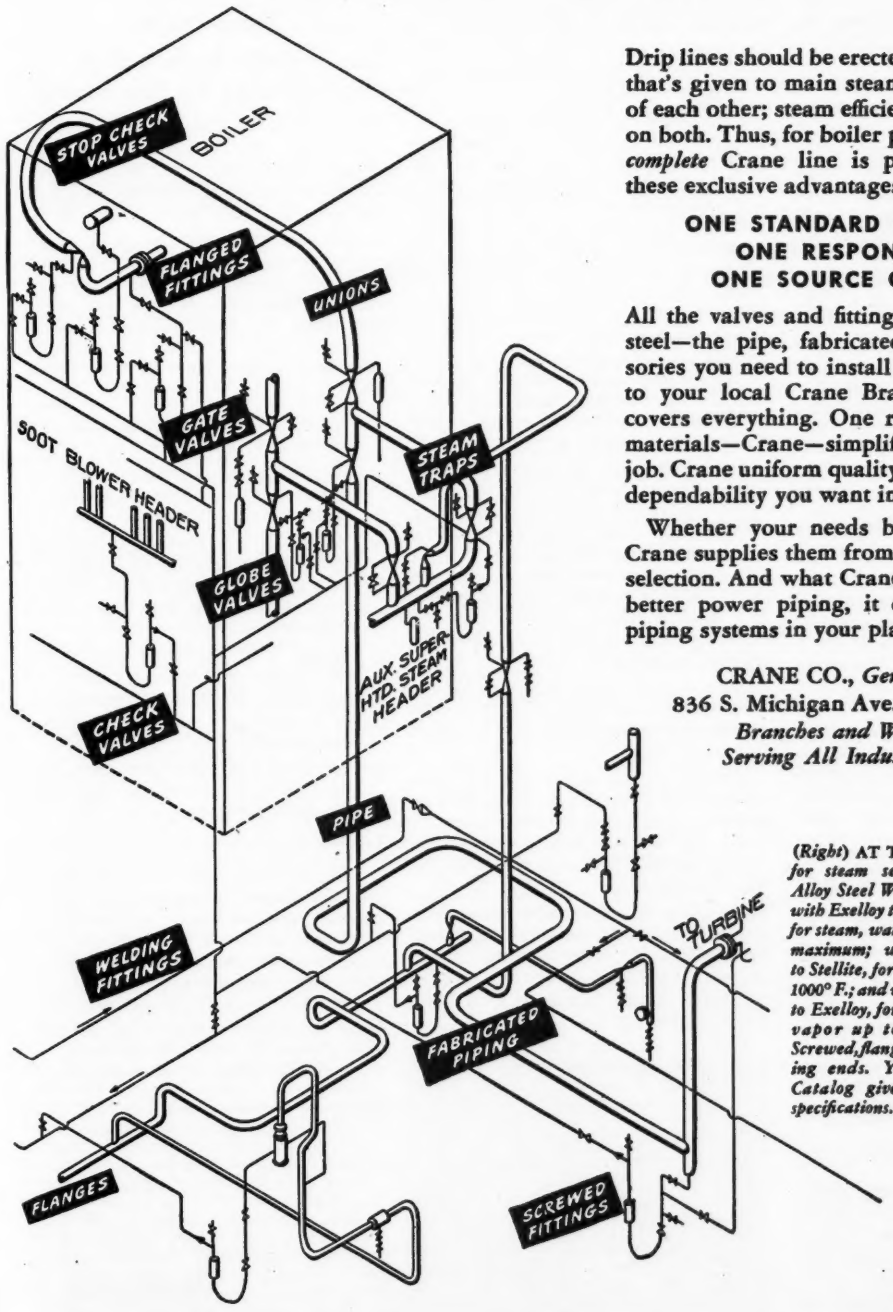

Drip lines should be erected with the same care that's given to main steam lines. They're part of each other; steam efficiency depends equally on both. Thus, for boiler piping especially, the *complete* Crane line is preferred because of these exclusive advantages:

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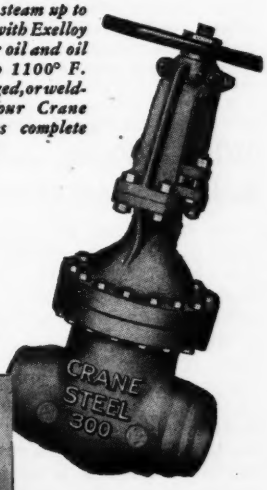

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more "popular" vein, but is no less scientific for that, since it was written for use in the general physics course at the University of Chicago. Both deal with the fundamental principles and modern conceptions of physics and require very little mathematics.

Atomic Physics, No. 9, also requires little mathematics to understand it. In our opinion, it is one of the best reviews of the entire present situation in atomic physics, showing the developments over the past 50 years, the relations between them — extremely important—and all the things that now make atomic energy control possible. One of the "must" books for understanding what is going on today.

The remaining books, Nos. 10 to 14, are written primarily for the intelligent non-scientists, to give them some conception of the nature of the physical world and the ways in which the developments in modern science affect all our thinking. Modern ideas in philosophy and logic are much different, because of our present knowledge of matter and energy, from those of the "classical" philosophers and logicians. For example, the explanations of the "quantum" by Max Planck some years ago and of the "principle of indeterminancy" by Heisenberg have completely altered all the philosophical conceptions of "cause" and "effect." Who is in a better position to explain this than Planck himself? He does it very simply and understandably.

We have included those last five books primarily because they explain relations between many of the mathematical and physical facts and the universe as a whole. This is not mere "high-brow-ism." It is intensely practical for any engineer, especially for one who is trying to study and figure things out for himself.

There, gentlemen, you have some of our ideas. We heartily welcome your suggestions on things F. K. should read and study in mathematics and physics. What books have you found clear, practical and helpful?

Question No. 336

What's Wrong in This Refrigeration Plant?

WE HAVE a fair sized refrigeration plant in the meat-packing firm where I work and it seems to me that there is something wrong either in the layout or the operation or both.

We have nine coolers, which we keep at about 36 or 37 F, and four freezers, which we would like to keep at —20 or —30 F, but which we get down to about —5 to —20 F, the latter temperature being a rarity. Sometimes we use one large machine to handle two of the freezers and the other 4 smaller machines to handle the coolers and other freezers and sometimes we use all the machines to draw from all the freezers and coolers.

Now, wouldn't we gain in capacity and economy by having some of the machines drawing from the high-temperature rooms only, with a back pressure of possibly 25 psi; and the other machines drawing from the low temperature rooms at about 10 in. of vacuum? What do you think of this?

Our back pressure is usually a few inches of vacuum.

I proposed that we use a heat exchanger for the gases coming back from the freezers and sub-cool the liquid going to the freezers. If we put one in, would it be best to allow all the liquid going to all the rooms to pass through it or only the liquid going to the freezers? If all the liquid went through the heat exchanger and only the return gas from the freezers would it prevent us from getting a low enough vapor pressure in the freezer coils? Does it do any good to use a heat exchanger on high-temperature rooms or should it be used only on below zero rooms?

We might put extra coils in some of the freezers and superheat the gas from the regular coils in the extra coils before drawing it back to the machines. Would this be better or not as good as the heat exchanger idea? Would it result in maintaining the desired vapor pressure in the coils with a positive back pressure at the machines?

Also, would it be a good plan to have one machine drawing from the freezers and exhausting into the other machines?

This plant seems to require a back pressure of 5 to 15 in. of vacuum to really get anywhere with the freezers. Does this denote insufficient evaporating surface, provided the coils are not frosted up?

Would it be advisable to have some type of superheat-actuated expansion valves on the freezers or would the higher temperature rooms being in the same system interfere with their proper operation?

One of the machines pumps oil badly although equipped with new piston rings. I put a trap on the oil separator to drain the oil back to the machine, which works fine; but can we do anything to stop it pumping the oil over?

Vancouver, B. C., Canada C. O. S.

Question No. 337

He Wants to Convert from Stoker to Oil Firing

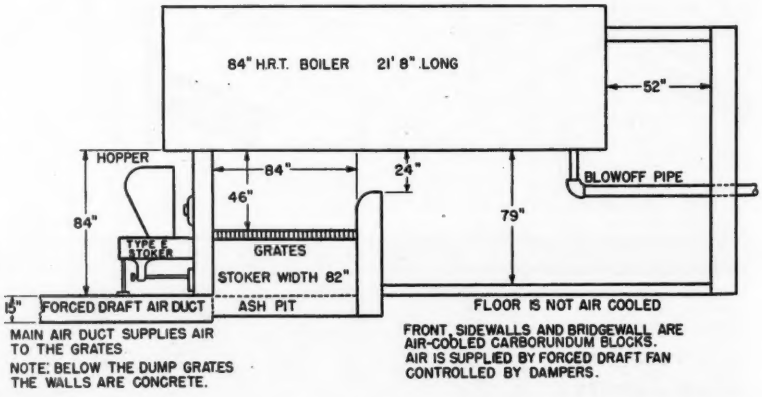
I WOULD LIKE to have readers' comments on the following questions about converting the HRT boiler shown in the attached drawing from the present stoker firing to oil firing.

This boiler would be in a plant where there are other oil-burning boilers, burning No. 6 oil with mechanical burners. If this one were put on oil, one more oil heater would be required to maintain the required oil temperature. Here are the questions:

1. Would you use a steam-atomizing or mechanical burner?
2. Would you use forced draft or the natural draft, which is 0.6 in. of water?
3. Would it be possible to remove the bridge wall only and leave the side walls as they are by coating them with a thin layer of plastic refractory?
4. Would it be better to remove all the present furnace brickwork and renew it with regular firebrick?
5. Is it necessary to make the floor air-cooled?
6. What is the best way to make this change so that it will give dependable, lasting service?

Lowell, Mass. C. W. H.

Editor's Note—Much of the information needed to answer several of these questions has already been published in POWER PLANT ENGINEERING. *See, for example, the following: Boiler Fireman's Handbook, Part 17, December, 1945; Answer No. 271, Q&A section, November, 1944, page 118; Why Do Solid Masonry Walls Fail, PE&E, May, 1944, page 104.*



Sketch of C. W. H's present boiler, which he wants to convert from stoker to oil firing

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Importance of Protective Film in Extending Condenser Tube Life

The character of the corrosion film which forms on condenser tubes during service is influenced primarily by the nature of the circulating water and the chemical composition of the alloy or metal from which the tubes are made. In general, corrosion films which form on brass are more easily removed than those formed on modified brasses, aluminum bronzes and copper-nickel alloys. The rate of film removal depends upon the temperature, velocity (extent of agitation), and of course the specific properties of the corrosive medium. Hence the nature and distribution of the corrosive film—whether it is continuous and impermeable, or permeable, with physical and chemical properties markedly different from the metal being corroded—has a tremendous influence on the rate of corrosion.

Two Types of Corrosion Films

Let us consider the corrosion films which form as belonging to two different classes—the invisible (frequently protective) and the visible (frequently non-protective). In between these two extremes are corrosion films which have varying degrees of protective values.

It has been observed repeatedly that the visible films, which are insoluble in the corroding medium, usually have the following characteristics: They are permeable to water (they permit the passage of a fluid through them). They are sufficiently dense to impede the flow of fresh corrosive solution to the metal surface (this may also slow up the rate of corrosion). They may be non-uniform or discontinuous, thus permitting the corrosive solution to come in contact with metal in certain areas and partially screen the metal in others. The corrosion may be increased in certain screened areas (under or around) by the formation of concentration cells. The metal under the thicker portions of partially permeable film usually becomes pitted (anodic area) or attacked by localized corrosion. The exposed metal or those areas covered with thinner films are only slightly corroded (cathodic area). The continuous accumulation of corrosion products of the same type helps to produce deeper pits or to enlarge the area being corroded.

The properties of visible corrosion films aid in the formation of the concentration cell (metal ion and oxygen) types of corrosion. The concentration cell begins to operate when the corroding substance is present in different concentrations at adjacent areas on the metal surface.

Foreign Matter Accelerates Corrosion

The nature and distribution of sand and slime from various growths, weeds, leaves, silt, ashes, sheels, ruts, etc., are also very important contributors to cell types of corrosion. When foreign materials of this nature contribute towards localizing corrosion, the resulting attack is commonly called "deposit attack."

It is known by power plant engineers that the removal of such debris by periodic cleaning using rubber plugs, bristly brushes or high pressure water or air applied at the exit end definitely prolongs the life of condenser tubes. The water box should be cleaned regularly and the paint should be kept intact. Of course, the intake tunnel should be kept clean and if necessary the channel should be dredged. If troubled with marine growth and slime, chlorination may be used. In all instances the metal is corroded (anodic area is pitted or dezincified) where the oxygen concentration is least, viz., where the corrosion film is thickest or under deposits of foreign material which may eventually become part of the corrosion scale. Where a thin deposit covers the metal (cathodic area) and therefore the oxygen concentration is the highest, the least amount of corrosion occurs.

7500 Square Foot Surface Condenser, courtesy Allis-Chalmers Manufacturing Company

Superior Corrosion Resisting Alloys Available

In such alloys as Cuzinal (aluminum brass), Duronze IV (aluminum bronze) and 70-30 copper-nickel, exposed to clean ocean water, the corrosion films are comparatively thin and of a more protective nature. Such films adhere more firmly to the parent metal and are more readily healed when bruised. Consequently the chance of localized corrosion (pitting) is reduced.

Besides reducing corrosion, the thinner corrosion films also possess better heat transfer characteristics than the thicker corrosion films and scales. This results in greater efficiency.

It follows therefore that there is a relationship between the character of the film and condenser tube life. Since the character of this film varies with the alloy and the corrosive environment it behooves every power engineer to seriously consider the superior qualifications of the more modern condenser tube alloys.

Preventive Measures Should Be Taken

Numerous devices have been designed, built and put into practical use to remove debris, entrained gases, and other substances from corrosive waters. The simplest device is the stationary screen which is quite effective within its limits. The rotating screen is widely used and is generally more satisfactory than the stationary screen since the debris, fish, sea weed, etc., are continuously being removed automatically.

The use of a wide generous tank with ample baffles is of proven effectiveness in removing debris and entrained gases. This is accomplished by using a tank which is considerably wider than the incoming stream of water. This slows down the flow sufficiently to allow the foreign matter to settle out from the water and the gases to rise and escape. The use of such tanks materially aids in increasing condenser tube life. It follows that condenser maintenance is appreciably reduced since less debris gets into the water box and the tubes themselves.

Field Tests Strongly Recommended

Many power engineers are looking into the possibilities of these alloys through the installation of test lots under actual service conditions or as field tests so that they will have available pertinent information as to the best alloys for their particular requirements or operating conditions. Here our Technical Service Department can be very helpful in working with power engineers in the selection of the alloy which will be most practical. If you do not have a copy of our Condenser Tube Manual, write for it today.

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Answer No. 327

Another Water System Problem—Redesign the Control

AT A SUMMER RESORT, said J. L. in the April issue, the water supply system consists of a spring as the source of supply, a concrete reservoir for storage, two single-phase, 3-hp motor-driven pumps for pumping from spring to reservoir and from reservoir to an open tank on a hill. The present piping and electrical control hook-ups were shown. It is desired now to remodel the control so that the operator can use either pump for pumping from the spring to the reservoir or from the reservoir to the tank. The pump serving the reservoir from the spring is to be hand-controlled and is generally left on during the night. The motor of the reservoir-to-hill-tank pump is to be controlled by float switches in the two tanks.

Here is the way one reader would redesign the control system to accomplish this purpose. Figure 1 shows the control system as it is now. Figure 2 shows how Jack Pitts would remodel it.

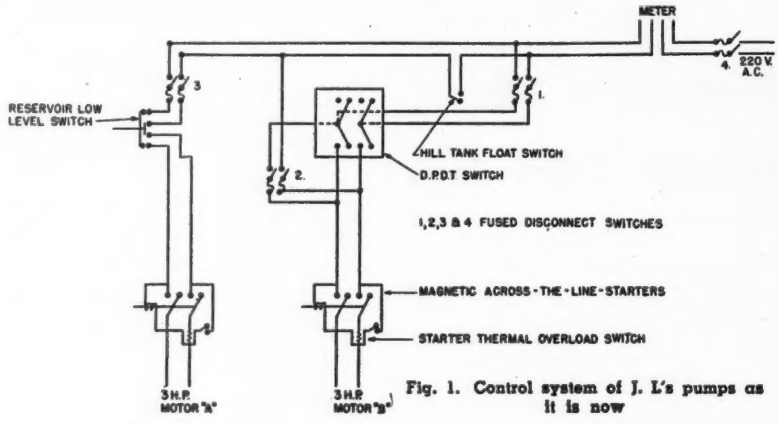


Fig. 1. Control system of J. L's pumps as it is now

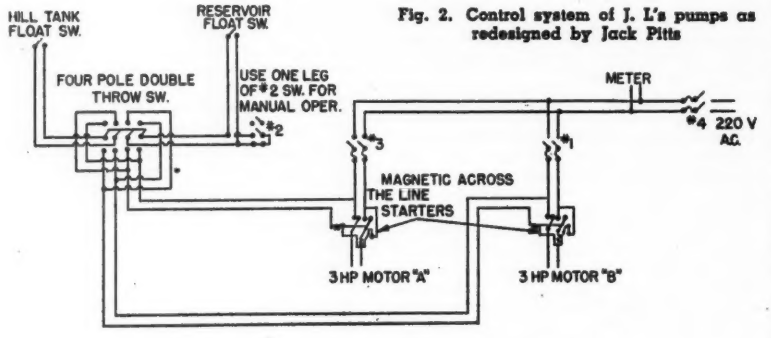


Fig. 2. Control system of J. L's pumps as redesigned by Jack Pitts

Redesign of Control system for J. L's pumps by Jack Pitts

WITH THE SYSTEM connected as shown in the sketch, when the four-pole, double-throw switch is closed in the top position, the reservoir float switch will operate motor "B" and the Hill tank float switch will operate motor "A." When the four-pole, double-throw switch is closed in the bottom position, the reservoir float switch will operate motor "A" and the Hill tank switch will operate motor "B." The No. 2 switch is for manual operation.

Ontario, Calif. JACK PITTS

Answer No. 313

Can This Boiler Be Changed to Give Dryer Steam?

Creighton Objects!—
Says the Boiler Code Does, too

IN YOUR April, 1946, issue, I noted a sketch by Leo Schulte showing a change of baffling on E. O. D.'s boiler intended to provide a method of drying the wet steam delivered by the boiler.

I do not agree with this type of setting, because the connecting steam tubes between the drums would be exposed to excessive temperatures, also the rear top steam drum above the water line, as well as any piping to the fittings connected to that drum.

I am afraid this would not be allowed in any state which recognizes the ASME Boiler Code.

San Francisco, Calif. ALLAN J. CREIGHTON

Preventative and Remedial Measures Needed

ON THIS question about dry steam from a boiler, there are two ways to correct such troubles, one, preventative and one remedial. A combination of the two is usually best.

First—preventative:

a; Have clean boiler feed, especially free of grease or soaps.

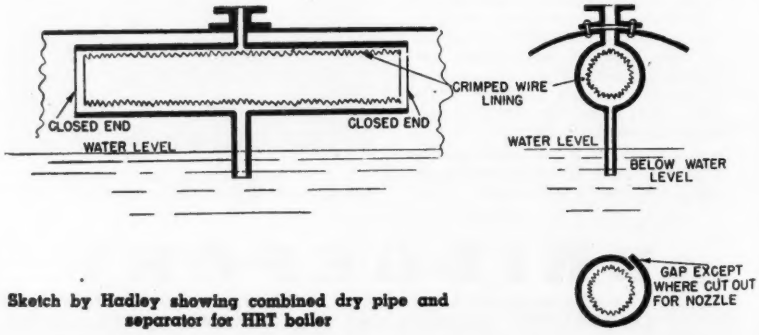
b; Keep water level as low as is safe.

c; Have steam outlet or nozzle at greatest possible distance from disengaging surface of water.

For example, in an HRT boiler when steaming hard, most of the steam is liberated back of the bridge wall and so the nozzle should be located well forward. In a longitudinal drum water tube boiler the steam is liberated almost entirely near the front drum head and the nozzle should be well to the rear. In a 4-drum bent tube boiler steam is liberated in the front and middle drums and the nozzle should be on the rear drum unless that is below normal level, in which case it should be on the middle drum for the usual tube layout. It helps to have all steaming tubes enter the drums as high as possible, and preferably above the water line. Even then, baffles should direct the flow downward and the greater the length of travel before reaching the outlet the better. A big drum is valuable for its separating value and not for its capacity as a steam receiver, or reservoir.

Second—remedial: A dry pipe, if used, should be larger than the outlet nozzle, the larger the better so as to have low velocity to let the water drop out. And it must have an ample drain, carried below the water level. Without this it is worse than none, and dangerous.

A better way is to install a separator, with its drain of good size



Sketch by Hadley showing combined dry pipe and separator for HRT boiler

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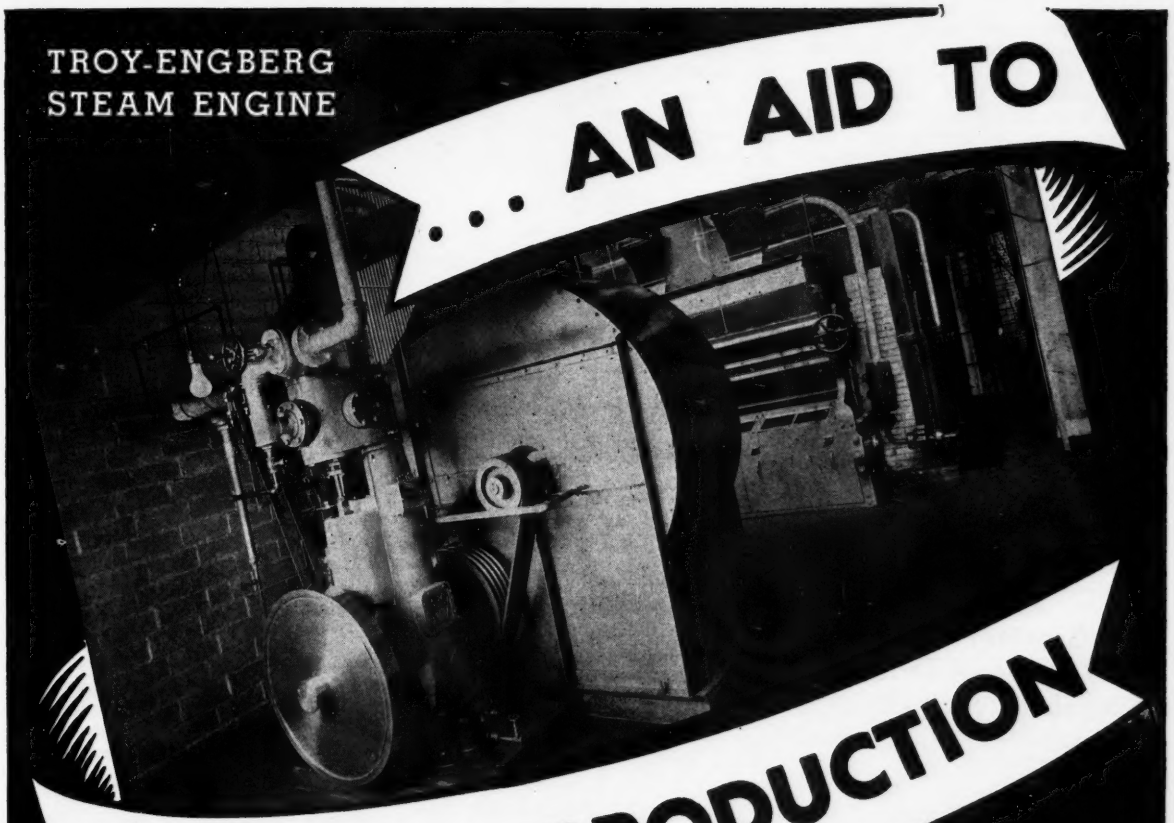

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and well submerged. Inside the boiler is the best location but, if not convenient, good results will be had from one in the steam lead. This usually means traps and they must be good and kept in working condition.

The sketch herewith shows the essentials of a combined dry-pipe and separator installed in an HRT shell. For a 6 in. dia. nozzle the dry pipe diameter should be at least twice the nozzle, or 12 in., its length at least 72 in., the width of the slot on top where the steam (wet) enters tangentially not over ⅝ in. and the submerged drain not less than 2 in.—and two drains would be better. There should be a liner of heavy crimped woven wire, rolled about 10 in. in dia. and secured centrally inside the dry-pipe. This will help to keep the swirling flow of steam from picking up the film of water or the sheet of water on the bottom.

Kansas City, Mo. STANTON A. HADLEY

Answer No. 328

Why Greater Pressure Drop with Live Steam Than with Exhaust Steam?

IN THE BUILDING heating system shown in the accompanying diagram, why is it, asked G. H. K. in the April issue that there is no trouble in supplying heat to every radiator in the building when the engines are operating and exhausting into the system but that there is when steam is taken from an outside steam company through the 2-in. reducing valve?

In the latter case, said G. H. K., when the reducing valve is maintaining a pressure of 3 psi on the downstream side, no pressure will show on the gage at point "B," whereas when the engine exhaust is used there is only about ½ lb drop between the engines and point "B." He asks if the engine exhaust pulsations have anything to do with this difference, also if the reducing valve is big enough.

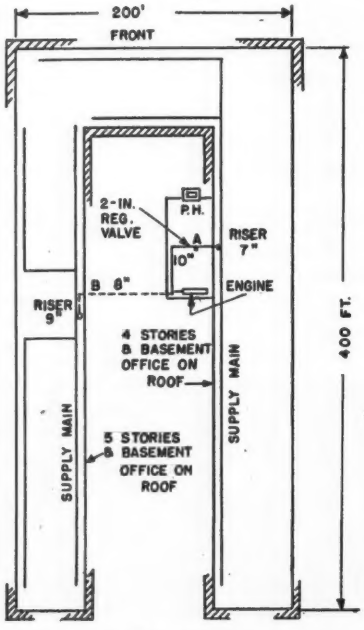

Diagram of G. H. K.'s heating system

Comments by Merryman

IN ANSWER to this problem:

1. It would appear that the 2-in. reducing valve in the problem is connected on the low side to a short run of pipe smaller than the 10-in. header, otherwise there could be no reading of 3 psi when the valve was supplying the system.

2. To check the pressure when using the reducing valve, I think that G. H. K. should connect a low pressure gage somewhere along the main between B and A, probably close to where the engine exhaust connects into the main. He will, undoubtedly, find that he has very little, if any, pressure in the 10 in. line.

3. The volume of this building is roughly 2,000,000 cu ft and, assuming a ratio of cubical contents to radiation at 100 to 1, there would be 20,000 sq ft of equivalent direct radiation. This is perhaps too low for that district.

4. 20,000 EDR with piping will condense approximately 0.3 lb per hr of low-pressure steam per sq ft EDR, or $0.3 \times 20{,}000 = 6000$ lb per hr total for the system.

5. Reference to catalogs of reducing valves containing valve flow charts will show that a 2-in. valve operating under those conditions will pass when wide open about 4500 lb per hr, as a maximum.

6. The steam at 120 psi from the street main, when introduced into the heating system through a reducing valve, should contain as much heating value as the exhaust steam and should heat the building equally well.

Spokane, Wash. JOHN W. MERRYMAN

Volumes of Steam May Explain It, Says Septor

THE CAUSE of the pressure drop in pipe lines of the heating system, some distance removed from the source of supply, when using live steam, may be due to the increased volume the pipes have to carry. Though the heat content per pound of reduced live steam is considerable higher than that of the exhaust steam, the heat per cubic foot is less, and the piping system must handle a greater volume.

Assuming the 120 psi steam is saturated, and for convenience taking the two working pressures 124 psia and 17 psia, this is the way it works out. 134 psia saturated steam reduced to 17 psia through reducing valve, has total heat of 1192.3 Btu per lb, 300 F total temperature and a volume of 26.36 cu ft per lb.

$$\text{Btu per cu ft} = \frac{1192.3}{26.36} = 41.43$$

The exhaust steam at 17 psia may contain from 10 to 12 per cent moisture, with a total heat of 1040 Btu per lb and a volume of 21 cu ft per lb.

$$\text{Btu per cu ft} = \frac{1040}{21} = 49.5$$

A difference of 8.07 Btu per cu ft or about 19.5 per cent.

There is also the possibility that the higher temperature of the live steam may affect the gage at point A and it is not registering the correct pressure; a slight increase in pressure at point A when using live steam may be necessary, to overcome pressure drop due to increased volume.

As to whether or not G. H. K. needs a larger reducing valve, if the present one will not keep the pressure up then he surely needs a larger one. It should not be too large however as reducing valves generally operate better at near full capacity.

RAYMOND SEPTOR

South Amboy, N. J.

Comments by Heldecker

THE UNUSUAL BEHAVIOR of G.H.K.'s steam gages is the basic principle upon which the modern steam flow meter is constructed. The two elbows in the steam pipe between the gages have about the same effect on the pressure in the pipe as the constriction used in the steam flow meter installation.

When a gas or liquid flows in a pipe, part of the head or pressure is converted into kinetic energy. The more rapid the flow, the greater the pressure drop. Figure 1 is a diagram of a pipe in which liquid moves at different speeds due to a constriction in the pipe. The pressure is lower at

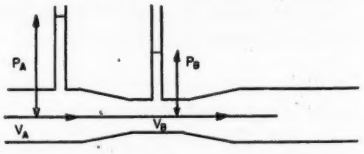

Fig. 1. Diagram showing how change in pipe size affects pressure and velocity

P_b because part of the heat at P_a has been converted to kinetic energy. The water has to move faster to get through the neck. Pressure may be express in terms of velocity; that is,

$$\text{head} = \frac{(\text{Velocity})^2}{64}$$

Referring to Fig. 1, by actual trial we would find that

$$\text{Pressure at } P_a + \frac{(\text{Velocity at } V_a)^2}{64} = \text{Pressure at } P_b + \frac{(\text{Velocity at } V_b)^2}{64}$$

It can be readily seen that when the pressures are the same, the ve-

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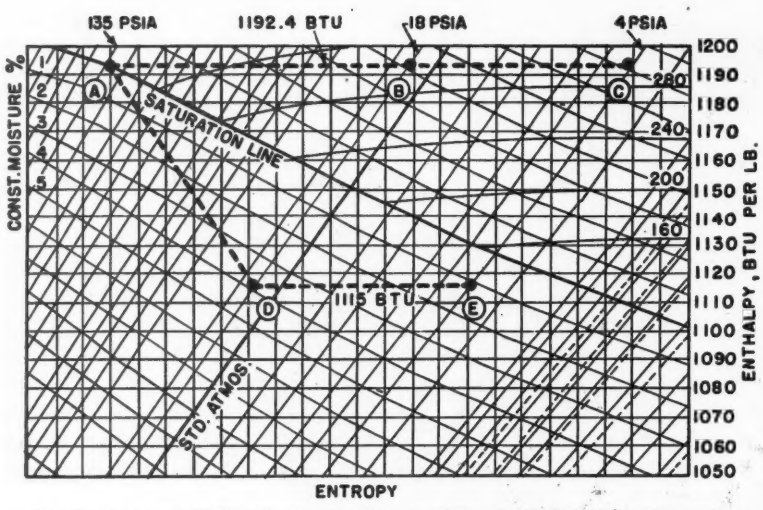

Fig. 2. Section of Mollier diagram showing conditions in G. H. K.'s heating system

locity equals zero. The greater the difference between the pressures, the greater becomes the numerical value for velocity.

Getting back to G. H. K's question why the steam gage at "B" drops to zero when the reducing valve is open, that is probably due to pressure drop caused by increased flow of steam from the reducing valve to the radiators. This increase over the steam engine exhaust flow is caused by the fact that the steam is superheated, which increases the capacity of the individual radiators of the heating system.

Referring to the Mollier diagram, Fig. 2, we find that the approximate condition of G. H. K.'s steam is as shown in the table.

Table showing steam conditions at various points in G. H. K.'s system

Code Location	A Engine Throttle	D Engine Exhaust	E To Radiator	A To Reducing Valve	B From Reducing Valve	C To Radiator
Pressure, gage ..	120 psi	3 psi	8 in. Hg	120 psi	3 psi	8 in. Hg
Pressure, abs ...	135 psi	18 psi	4 psi	135 psi	18 psi	4 psi
Btu Content	1192.4	1115	1115	1192.4	1192.4	1192.4
Temp, deg F....	350	222	150	350	300	300
Quality	100%	96%	99%	100%		

The temperature of the superheated steam in the radiators will be somewhat lower than the figure in the tabulation, also the moisture content of the exhaust steam will be greater than shown. This is due to energy and radiation losses in the pipes.

Given identical radiators, the amount of heat given up to the surrounding air is dependent upon the temperature difference between the steam and the air.

For example:

70 deg = temperature of air to be heated

150 deg (temperature of exhaust steam — 70 deg = 80 deg difference

300 deg (temperature of reducing valve steam) — 70 deg = 230 deg difference

The temperature differential for live steam is 3 times that of exhaust steam. It probably isn't this high in G. H. K.'s radiators, but it does illustrate how the capacity of a radiator is increased by super-heating. Before making any changes in equipment, we suggest a desuperheater to be placed in the pipe on the 3-lb. side of the reducing valve, as in Fig. 3. This could be a spray nozzle using water from the radiator drains; or maybe a ½-in. pipe screwed into the top of the steam line.

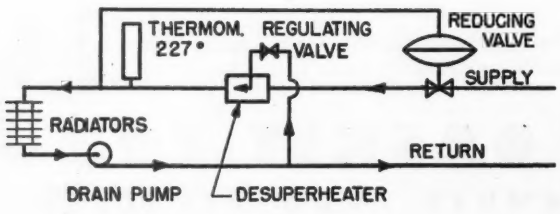

Fig. 3. Diagram showing where desuperheater could be installed in G. H. K.'s heating system steam supply line

This arrangement would produce steam from the reducing valve having about the same characteristics as the wet steam from the engine.

Chicago, Ill. WALTER HEIDECKER

Answer No. 331

How Build This Walk-In Refrigerator?

FOR PRACTICAL PURPOSES in the small plant, there is little difference in the heat insulating properties of cork, wool, hair felt, rock wool, or such trademarked substances for low temperature insulation as calorax, insulite, kapok, etc. Four inches of any of these will effectively insulate any cooling room held above 32 F.

If power is cheap and storage space at a premium, or if your cooler walls are of hollow frame, two inches of rigid or semi-rigid wallboard made of any of these substances will suffice. The insulating effect of the fourth inch of any insulating material is only a small fraction of the first inch. Unless fire hazard exists, I recommend the use of that insulation most economically available, and two to four inches thick.

Size of load, not size of box, determines proper size of the compressor. Since the box is to be "jerk" loaded, presumably twice daily, I recommend the use of a forced-circulation, finned-type evaporator, with fan wired to run only when the compressor runs. The compressor should be 3 in. by 3 in., with 5-hp motor, assuming the maximum load at the equivalent of 50 gal. of milk twice daily, milk at 90 F. With this unit and evaporator capacity to maintain 15-psi suction pressure, such a load should be reduced to cooler temperature in about 4 hours.

While any 3-in.-by-3-in. unit system will handle this load, I highly recommend the York Y-15. This is one of the simplest machines for the non-mechanic to operate. It is splash oiled, with no oil filter to clean and no oil pump to lose its prime. Safety heads and discharge valves are one and the same. On two occasions I have seen one of these compressors run six months without stopping. Change chankcase oil once or twice yearly.

I have assumed that ammonia is to be the refrigerant.

Use thermostatic expansion valve of 1 to 2 tons capacity on the evaporator. In degree, the capacity of the compressor may be reduced by using a smaller pulley on the motor, or by using motor with lower rpm. This may be necessary, or advisable, in systems where too low a suction pressure is maintained by the compressor.

If automatic control is used, the feeler capsule should be placed in a corner of the box not subject to air currents from an open door. The body of the controller should be set up outside the box.

GEORGE HOLMAN

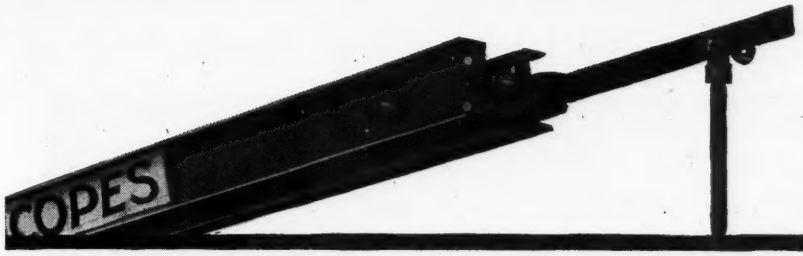

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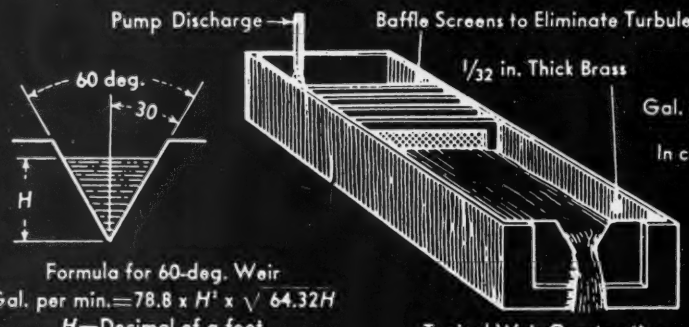
Table Giving the Discharge Over Weirs

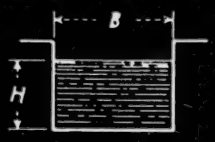
THE TABLE BELOW gives the flow of water in gallons per minute for 60-deg. and rectangular weir gages. Temperature of the water is assumed to be 60 deg. F. Output of the pump is discharged into a weir box constructed as shown. Dimension H is measured at least 6 inches back of weir plate by a scale graduated in tenths of an inch.



Formula for 60-deg. Weir
Gal. per min. = 78.8 x H^2 x $\sqrt{64.32H}$
H = Decimal of a foot

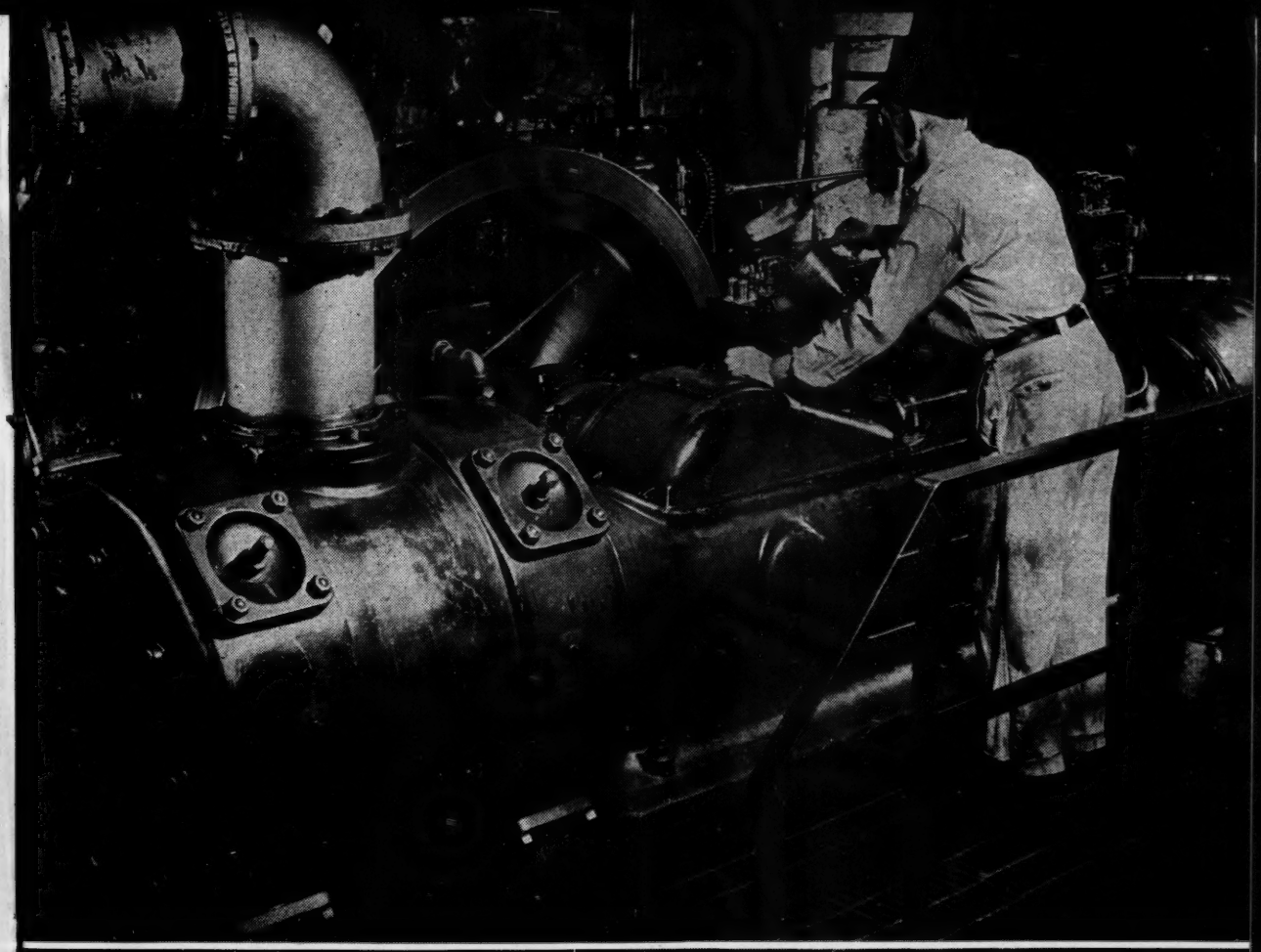
Typical Weir Construction

Formula for Rectangular Weir
Gal. per min. = $1494.504\,(B - 0.2H)\,H\sqrt{H}$
H and B = Decimal of a foot.
In calculating the chart, dimension B was assumed to be 7 inches.



		60-deg. Weir	Rect. Weir			60-deg. Weir	Rect. Weir			60-deg. Weir	Rect. Weir
Inches	Feet (H)	Gal. per min.	Gal. per min.	Inches	Feet (H)	Gal. per min.	Gal. per min.	Inches	Feet (H)	Gal. per min.	Gal. per min.
0.1	0.008		0.6	2.1	0.175	8.1	59.9	4.1	0.342	43.1	153.7
0.2	0.017		1.8	2.2	0.183	9.1	64.1	4.2	0.350	45.8	158.8
0.3	0.025		3.4	2.3	0.192	10.2	68.3	4.3	0.358	48.6	164.0
0.4	0.033		5.2	2.4	0.200	11.3	72.6	4.4	0.367	51.5	169.2
0.5	0.042		7.3	2.5	0.208	12.5	76.9	4.5	0.375	54.4	174.4
0.6	0.050	0.35	9.5	2.6	0.217	13.8	81.4	4.6	0.383	57.5	179.7
0.7	0.058	0.52	12.0	2.7	0.225	15.2	85.8	4.7	0.392	60.7	185.0
0.8	0.067	0.72	14.6	2.8	0.233	16.6	90.4	4.8	0.400	64.0	190.3
0.9	0.075	1.0	17.4	2.9	0.242	18.1	94.9	4.9	0.408	67.3	195.6
1.0	0.083	1.3	20.3	3.0	0.250	19.7	99.6	5.0	0.417	70.8	200.9
1.1	0.092	1.6	23.4	3.1	0.258	21.4	104.3	5.1	0.425	74.4	206.3
1.2	0.100	2.0	26.6	3.2	0.267	23.2	109.0	5.2	0.433	78.0	211.7
1.3	0.108	2.4	29.9	3.3	0.275	25.1	113.8	5.3	0.442	81.9	217.1
1.4	0.117	2.9	33.3	3.4	0.283	27.0	118.7	5.4	0.450	85.8	225.5
1.5	0.125	3.5	36.8	3.5	0.292	29.0	123.5	5.5	0.458	89.9	228.0
1.6	0.133	4.1	40.5	3.6	0.300	31.1	128.5	5.6	0.467	94.0	233.4
1.7	0.142	4.8	44.2	3.7	0.308	33.5	133.4	5.7	0.475	98.3	238.9
1.8	0.150	5.5	48.0	3.8	0.317	35.6	138.4	5.8	0.483	102.6	244.4
1.9	0.158	6.3	51.9	3.9	0.325	38.0	143.5	5.9	0.492	107.0	249.8
2.0	0.167	7.2	55.9	4.0	0.333	40.5	148.6	6.0	0.500	111.7	255.3

Of the various methods of measuring the flow of a stream of water the weir is one of the simplest and if the proper precautions are taken, the results are quite accurate. The weir consists of an obstruction or dam placed in a channel so that all the water in the channel must flow over it. It may extend the full width of the channel or comprise a sharp-edged notch, rectangular or otherwise, cut in the obstruction, in which case it is called a weir with end contractions. Sometimes weirs are rectangular, in other cases they are V shaped. Both types are shown in the chart presented on this page. The flow of water over a weir can be calculated by formulas but in the table above the flow of water in gallons per minute is given directly both for 60 degree and rectangular weirs. The table should be useful to anyone having to make hydraulic measurements and is reproduced here by courtesy of the Pioneer Pump & Manufacturing Company of Detroit, Michigan. The chart is especially handy in measuring the capacity of pumps.



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Southwark Station

(Continued from page 63)

voltage, can be conveniently located. The 50,000-amp breakers as required for the lower voltage would necessitate more room than is readily available. The copper requirements at the higher voltage are, of course, about 50 per cent of those at the lower voltage and the voltage drop with full-voltage starting motors is correspondingly decreased.

It is believed that personnel safety will be as great with 440 v, since all of the equipment and circuits will be enclosed, and since work will be done on such equipment and circuits only when they are blocked out. Such blocking is in accordance with the established practice for the 220-v system of the company.

For lighting service, there will be installed separate single-phase 4,000-220/110-v transformers with 10 per cent induction regulators tapped to the feeds to the 4000-440-v service banks in the switchhouse and heater bay.

Motor Types and Ratings

All of the motors, both 4 kv and 440 v, will be of the squirrel-cage type, except the 4-kv air-compressor motor, which will be synchronous. In all cases where speed variation is required, hydraulic couplings will be used.

The motor capacities on the 4-kv system will range from 200 hp for the pulverizer and exhauster units to 1500 hp for the induced draft fan motors. Motor speed for the various services will range from 600 to 1800 rpm.

Motors below 200 hp down to a minimum of ½ hp will be supplied at 440 v.

4-Kv System Control and Protection

All of the breakers involved in the 4-kv auxiliary power facilities will be air circuit breakers of the magnetic type. The source banks (13.8-4 kv) will be protected by differential relays tripping the high-voltage and low-voltage breakers while the service banks (4,000-440 v) will be protected by overload relays. The 4-kv motors will be protected by phase overload relays in 2 phases and a neutral overload relay, thus providing phase and ground protection with three relays per motor. The relays will be set to operate on fault currents rather than on overload currents.

Short circuit duties on the 4-kv circuit breakers will be limited by reactors in the circuits to the supply transformers and in the auxiliary generator feeds to the busses. The normal breaker duty will be 94,000 kva, the breakers being rated 100,000 and 150,000 kva. The higher-rated breakers are required on the feeders because of increased duties during periods of parallel operation of sources.

Various sections of the plant, such as the switchhouse, boiler house, and coal tower will each be supplied by two air-cooled transformer banks of 750 kva or 500 kva, connected solidly to 440-v busses in a unit arrangement at suitable locations for local distribution.

The smaller motors up to and including 50 hp, in general, will be controlled by standard across-the-line-type starters, equipped with fuses for fault protection and with thermal elements for overload protection. The starters are provided with control transformers to reduce the control voltage to 220 v where the circuit would be exposed on the back of a switchboard.

For circuits to motors of greater than 50 hp, air circuit breakers of 25,000-amp interrupting capacity will be used. In a number of instances, the air circuit breakers will be supplemented by contractors where frequent operation is required beyond normal breaker capabilities.

In the light of past practice and experience secured from other generating stations on the system, it is believed that the auxiliary power design as developed for Southwark will result in reliable, expeditious and economical operation.

REFERENCES

1. "Southwark Station Will Augment Power Facilities in Philadelphia Area," by N. J. Walker and B. E. Hagy—*Electric Light and Power*.—June, 1946.
2. "Philadelphia Electric Company's Southwark Station—Planning the Mechanical Features," by E. L. Hopping—*Electrical World*—June 22, 1946.
3. "Philadelphia Electric Company's Southwark Station—Planning the Electrical Features," by L. R. Gaty and E. B. Shew—*Electrical World*—July 6, 1946.

District Heating

(Continued from page 71)

present soot be-fouled atmosphere which is the curse of every city in Winter time, and which destroys health and property to an astounding grand total.

The damage to health and property from thousands of smoking heating plants has continued to provoke extensive civic and political indignation. Anti-smoke laws have continued to fail in their purpose. A central steam utility is the only and final answer to the problem and public political temper will be such when war's work is done, to force this realistic solution of this problem to stop this terrible smoke damage.

Russia, in building new cities and expanding old ones, has pointed the way by building central heating utilities to serve the new areas. England is now planning heating utilities in its comprehensive plans for rebuilding the demolished areas. State universities and other institutions have long recognized the economic wisdom of one central heating utility to serve a group of buildings spread over a wide area. These steam utilities for American cities are inevitable and will develop rapidly in the post war period.

Fisk and Northwest Burn Oil

(Continued from page 87)

header system. These burners, which are B & W steam atomizing Y-jet burners, of 6 gpm capacity each, were installed as shown in Fig. 2.

Oil burner guns, 16 on each of the two Unit 15 boilers and 24 on each of the two Unit 17 boilers, were installed in the coal burners, which are in the roof of the primary furnace of each boiler. This was done by inserting them vertically through openings made in the casings at suitable points. The oil burners pass between the roof tubes, the burner tips projecting a short distance into the furnace. There was no necessity for removing or making major changes to the coal burners nor for making changes in the draft system. Oil and steam supply headers, to which individual burners are connected by flexible hose in the usual manner, were installed as shown in Fig. 2.

The total of 80 burners installed on Units 15 and 17 have a combined capacity of approximately 480 gpm, and are more than capable of firing the four boilers to produce their full steam output.

Northwest Station

At Northwest Station, the same general procedure is being followed as outlined above. The three high-pressure pulverized fuel fired boilers of the topping installation are the ones being converted to oil firing. These are Combustion Engineering Co. units, each capable of generating 425,000 lb of steam per hr at 1250 psi, 925 F. This steam is supplied to an Allis-Chalmers 50,000-kw topping turbine generator, which exhausts to low-pressure units. The total generating capacity of the topping unit and its associated low-pressure equipment is 135,000 kw.

Here, too, provision has been made for supplying Bunker *C* fuel oil from 12 standard tank cars spotted on two railroad tracks of the station. Four of these cars are held for standby, the others used as the normal supply. As at Fisk, oil and steam lines have been installed for delivering and heating the oil.

Oil Pumping and Heating at Northwest

From the tank cars, oil flows to the suction of two Schutte & Koerting 150-gpm gear-type oil transfer pumps, which discharge it to a 3000-gal transfer tank. From this tank, three Schutte & Koerting 125-gpm gear type oil pumps, designed for discharge pressure of 350 psi, pump the oil to a Griscom-Russell G-fin section heater, fabricated in the same way as at Fisk.

From the oil heater the oil is delivered to the burners through a main header with branch headers extending entirely around each boiler to supply the oil burners in the four

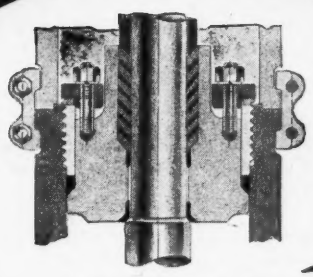
(Continued on page 124)

New!

TWO Edward Designs FOR TOP PRESSURE-TEMPERATUR OPERATING CONDITIONS

PRESSURE-SEALED BONNET VALVES

NON-RETURN VALVE, at right, shows Edward pressure-seal design. Valve incorporates flow directional guiding, internal contouring for extremely low pressure drop, closure indicator and Edward Impactor handwheel.



Principal parts of pressure-seal connection. This construction cuts weight of standard high pressure, high tempera- ve by as much as 50 per cent.

SMALL SEALED BONNET VALVES

Edward **UNIVALVE**, forged steel globe valve with patented welded bonnet, integral hard-surfaced seat, hard-surfaced disk, bolted gland, bronze yoke bushing and one-piece bonnet. Sizes ½"-2".

See how **UNIVALVE** construction keeps body and bonnet in perfect alignment for welding, cuts pressure drop, reduces erosion-producing turbulence, yet keeps features of globe valve tightness.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

EXPECT THE BEST IN NEW STEEL VALVE DEVELOPMENTS FROM EDWARD!

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

Sludge, Tar Purgers

DEVELOPMENT of a new product called Stano-Purge for cleaning crankcases and lubrication systems of engines and another new product named Stano-Vim for purging fuel burning systems of gasoline engines is announced by Standard Oil Co. of Indiana. Neither product is generally available yet,—but both will be soon.

Stano-Purge is designed to remove loose crankcase sludge and clean oil screens and passages. Stano-Vim's function is to remove varnish, gum, and carbon deposits from valve stems, manifold, and intake valve parts, remove combustion chamber deposits, and clean fouled spark plugs.

Both new products have high solvency for resins and gums formed by deterioration of motor oil and low volatility with high flash point—which will minimize fire hazards. Their aromatic solvents content is more than 90 per cent. They have the pronounced odor characteristic of naphthalenes.

Voltage Regulator

BURLINGTON INSTRUMENT CO., Burlington, Iowa announces this new voltage regulator used in regulating AC voltage of engine-generator sets, stationary or portable operation. Available in 50/60 or 400 cycle models and for use on a wide range of AC voltages with the use of a potential transformer. Rating of contacts 2 amperes DC on a 125 v exciter. Cross current features available for parallel operation of two or more AC generators.

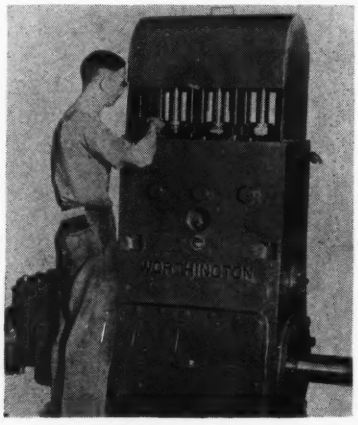
Semi-flush mounting with all connections brought to a terminal block

in rear of case. Rugged construction, simplified design, accessibility of operating unit mounted on the rear of hinged cover. No special tools required for replacement of parts or contact adjustment. All metal parts cadmium plated and chromate dipped with the exception of current carrying parts which are tin plated. Automatic polarity reversing of current through contacts every 5 hours of operation gives maximum contact life. Automatic-manual switch enables operator to preset manual control rheostat and to operate either automatic or manual by merely throwing the switch. Unique damping principle gives closer regulation on low power factor applications. Close tolerances in manufacturing and skilled assembly operations assure long life of unit and trouble free operation. Other models available for front of board or special installations.

Variable Stroke Pump

AN IMPROVED variable stroke triplex pump termed the Automatic Variflo is now in production by the Worthington Pump and Machinery Corp.

The objectives in the development of the pump have been the design of a high pressure triplex pump having stepless 0-100 per cent capacity variation, which would afford increased dependability and easier maintenance for this service. The photograph shows a unit rated for a 75 hp driving motor. Produced as a Variflo Pump in identically the same frame as used

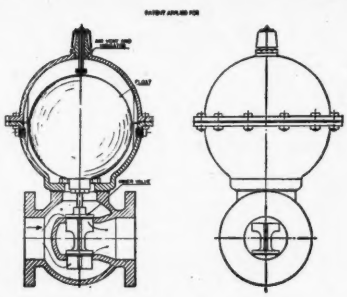


for the corresponding size of constant stroke pump it has the same dimensions except for the control cylinder shown on the left of the pump. This space taken by the control cylinder would be allowed as clearance space in any event.

The compactness, accessibility and pleasing appearance of this pump is accomplished by locating the crankshaft at the base, in the fully enclosed frame. Bearings are of the roller type. Positive, automatic pressure lubrication is provided by a direct driven gear oil pump. The stroke changing elements and other bearings are flooded with filtered oil at all times. The oil pump also provides oil pressure for operating the hydraulic stroke control cylinder.

Air-Lok Valve

DEVELOPMENT of a new type of valve, designated as the Air-Lok, for use on gathering lines connected to oil field lease tanks, is announced by the Davis Regulator Co., 2508 South Washtenaw, Chicago, Ill. A number of these valves are now in service in areas where it is common practice to use one pump to draw oil from several different tanks. The primary function of the Air-Lok is to automatically close the line in which it is installed, as soon as the withdrawal of liquid is completed and before any air or vapor is pumped into the system. This has not always been accomplished in the past with manually operated shut-off valves dependent



upon the attention of a tank gager for their proper manipulation.

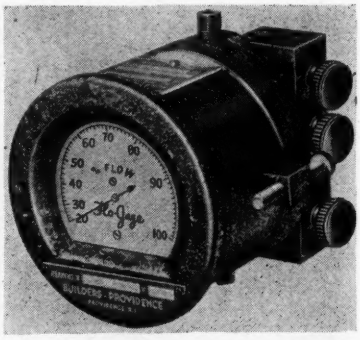
There is less likelihood of pumping equipment becoming damaged by racing under a no-load condition. By effecting a tight shut-off in the line, it becomes practical to install a vacuum switch in the line near the pump, which will stop an electric or gasoline pumping engine soon after the valve closes.

The unit consists of a spherical float connected to a balanced double-disc valve. With oil available in the gathering line, the liquid level rises in the float chamber and causes the valve to open. Threaded connections are provided in the float chamber for possible installation of equalizing lines, if found desirable.

At present, it is offered in two sizes with flanged connections for use on 3-in. or 4-in. lines. The body is made up of semi-steel castings and the interior trim is corrosion-resistant nickel iron.

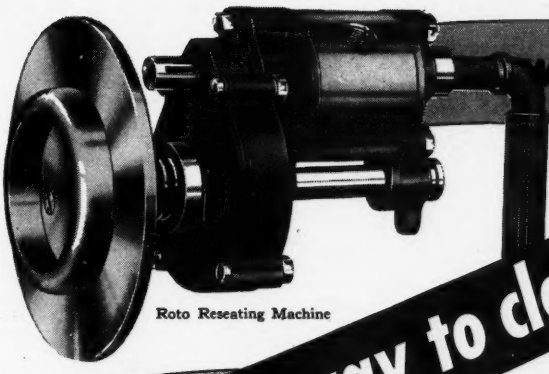
Flow Indicator

FLO-GAGE—a simple, inexpensive flow indicator has just been announced by Builders-Providence, Inc., 45 Codding Street, Providence, R. I. This



new rate of flow indicator for water, steam and air promotes the efficient utilization of liquids and/or gases consumed, particularly by the elimination of wasteful excess.

This midget differential meter indicates rate of flow of liquids and gases through lines containing orifices, venturi tubes and insert nozzles as differential producers and also indicates liquid level and pressure differences. It is said to be particularly useful as an operating guide in manually adjusting valve positions at the



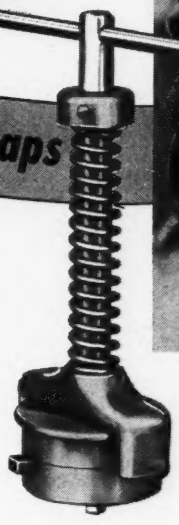
Roto Reseating Machine

A quick way to clean BOILER HEADERS

with outside caps

with inside caps

Illustrating ease of operation of Roto Hand Hole Seat Scraper



Roto Hand-Hole Seat Scraper for Heine Boiler Headers

Roto offers you a quick, easy means of assuring tight, leak-proof joints between boiler headers and caps. The Roto Reseating Machine removes scale, rust or other adhering matter from headers with outside caps and provides a smooth, true fit.

For boiler headers with inside caps Roto offers a simple hand-hole seat scraper which cleans either round or oval holes. These machines have been used widely for many years, and are sold on a money-back guarantee of satisfaction.

ROTO RESEATING MACHINE

This air-driven machine cleans headers and caps with an abrasive cloth disk fastened to a flat surface plate whose pilot ring accurately centers the disk on the gasket seat. Caps are cleaned by fastening the machine in a vise and holding the cap against the disk. Three pilot rings are furnished; one for the header and two for cleaning both sides of the caps.

The inexpensive abrasive disk is easily replaceable when worn, assuring a true grinding surface at all times. The machine is light (10 lbs) and convenient to handle. It develops 1 hp at 5,000 rpm, and is geared down 5 to 1 to provide ample torque. Send for details and prices.

NOTE—This machine can also be used for cleaning ½" to 1½" condenser tubes by simply removing the surface plate and attaching Roto Extension Shafting with a fluted drill or wire brush.

ROTO HAND-HOLE SEAT SCRAPER

This simple, hand-operated tool consists of a cutting head with retractable cutters, mounted on the end of a revolving spindle having a bearing in a substantial yoke. An adjustable spring automatically maintains tension on the cutters, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right and the job is done. A half turn to the left releases the machine.

Roto Scrapers are available for standard round or oval holes. Minor adjustments make them suitable for special sizes or conditions. Write for details and prices.

Make of Boiler	Tube Size	Opening
Babcock & Wilcox	4"	Oval
Babcock & Wilcox No. 40 Header	3¼"	Oval
Babcock & Wilcox No. 41 Header	2"	Oval
Babcock & Wilcox Superheater	2"	Round
Edge Moor	4"	Oval
Heine	3½"	Round
Keeler	4"	Round

ROTO Division of ELLIOTT COMPANY

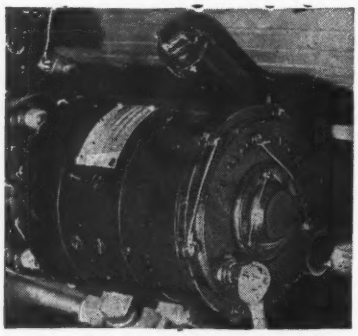
147 SUSSEX AVENUE - - - NEWARK 1, N. J.

start of a cycle of operations as well as in providing continuous information on flow rates so that efficient operation may be maintained throughout the complete cycle. The Flo-Gage can be used to assure an adequate supply and economical consumption of steam or air in agitating the contents in vats, tanks, dryers; of water in backwashing water filters and softeners; of cooling water for condensers, tanks, process equipment or machines; of cooling oil for electrical equipment; etc.

Features are its durable simplicity, accuracy, legibility, sensitivity and low cost. It requires very little space, is easy to install, and requires no mercury or auxiliary power. The gauge has no stuffing box and requires a minimum of maintenance . . . can be furnished to measure such units as gallons per minute, cubic feet per hour, etc., and indicates rate of flow within 2 per cent of full scale. The gauge mechanism is enclosed in a heavy semi-steel chamber having a thick prestressed glass window designed for an operating pressure of 500 psi.

Gas Turbine Electric Starters

TO START SUCH jet-propulsion turbines as the 19B, a 10-hp lightweight starter has been engineered. The job of this starter is to bring the compressor and turbine rotor from standstill to at least 2000 rpm in about 15 sec. The starter is rated at 10 hp, 17-v. at 6000 rpm (it uses a 4 to 1 gear) but develops 18 hp at peak output. The rating is on a 30 sec. basis. Even so the weight is light—



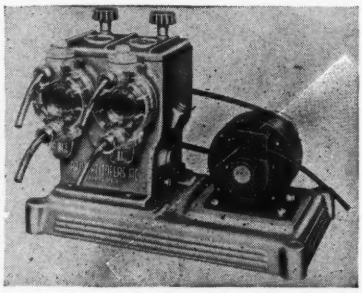
only 31 lb. (A 10-hp, 1800-rpm d-c motor weighs more than 450 lb.) A multiple-plate friction clutch is interposed between the motor and the jaw engagement to enable most rapid starting with safety.

The starter gets its power from the plane's 24-v batteries. To obtain maximum power with least drain on the battery, the motor was designed with impedance to match that of the battery and circuit. Since the inrush current is approximately 1800 amp a serious commutation problem had to be overcome, and was solved by the use of a special grade of halide-treated brush. So critical is the performance of the starter to brush type that a change in brushes may change the available peak output from 8 to 18 hp.

This starter is but one of three types now in production and is the forerunner of several types and sizes that will be required for gas turbine starting. Already work is begun on a starter about half as large for accessory gas-turbine power plants. On the other hand propeller-drive gas-turbines will require starters several times more powerful than this first one.

Chemical Feeder

THE DUPLEX DELUXE Chem-O-Feeder, a new chemical diaphragm type proportioning pump delivering chemical reagents in an almost continuous stream, has just been released for civilian use by Proportioneers, Inc., 46 Codding Street, Providence,

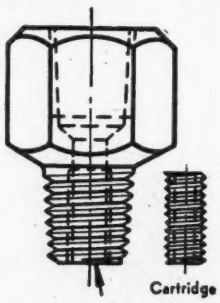


R. I. It is designed for the positive injection of one or two chemicals at predetermined and adjustable rates and is adapted for many uses including feeding chemicals for water sterilization.

The feeding rate of each chemical is individually adjustable for coarse variations by changing the stroking rate through a two-step cone pulley and belt arrangement. For fine variations, a stroke length adjustment knob on top of the feeder instantly varies the amount of solution fed per stroke. Transparent plastic reagent heads bare vital operating parts, such as diaphragms and check valves, to visual observation by the operator while the equipment is in operation. Also, each discharge stroke of the feeder is visible in sight feeder domes and any feeding irregularity may be detected. Moving parts inside the rugged unit case operate in an oil bath, resulting in long wearing life.

Cartridge Snubber

A NEW TYPE of snubber, or pulsation dampener, has been developed by the Helicoid Gage Division of American Chain & Cable Co. Inc., Bridgeport, Conn. This little device takes advantage of the use of pow-



dered metal through which the pressure medium must pass. The compressed powdered metal is in the form of a cartridge which can be inserted directly in the gage socket, or in a small separate connecting piece attached to the gage socket.

The compressed powdered metal is made in various porosities for air or gas, for water or steam, or for oil. It has been found that this cartridge snubber is very effective for reducing or eliminating violent pressure pulsations.

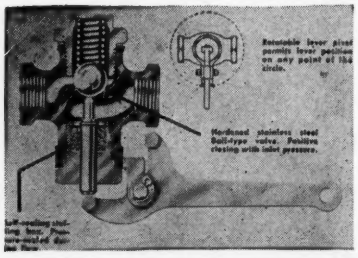
Air Operating Valve

A NEW self-sealing, air operating, ball type valve, known as Type BA, has been announced by Leslie Co. 257 Delafield Avenue, Lyndhurst, N. J.

Fitted with a hand opening lever and a rotatable pivot so that the lever can be located in any position, this new valve can be opened instantly from almost any position with either a horizontal or vertical pull. Ball valve closes tight with inlet pressure and will not collect dirt or other foreign matter.

The stuffing box is not accessible to tampering or adjustment and is self-packed by the operating pressure when the valve is open, permitting flow. Operating pressures up to 200 psi are recommended. Constructed with cast iron bodies, integral seating surfaces, screwed connections, and in ½ in. size.

When fitted with a cam operated lever, this valve becomes Type BAC and permits instantaneous valve

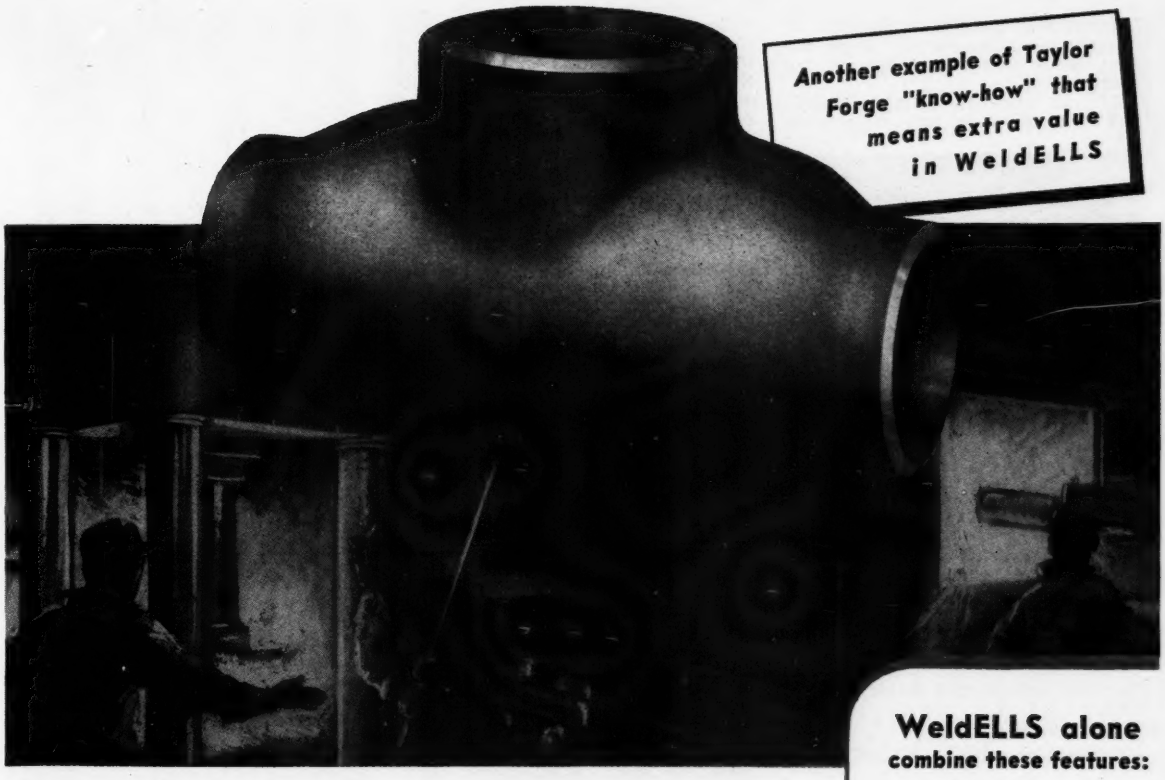


opening and closing by throwing the lever in the desired direction. The lever is held in the position thrown until manually returned to the original position. The yoke supporting the lever can be rotated around the valve bonnet to any desired location. Enlarged lever end provides easy visual check on inner valve position.

Fire Extinguisher

RANDOLPH LABORATORIES, 8 E. Kinzie St., Chicago, has produced a new trigger-touch 15 lb CO_2 extinguisher that is carried and operated with uninterrupted, single-sweep action. Grasping the unit by its arched-steel handle, the operator removes the extinguisher from its bracket, carries it with only one hand. The other arm is free to remove obstacles and open doors while en route to the scene of action.

On approaching the fire, the operator grasps the nozzle handle with his free arm, aims it at the base of the flames. One touch of the thumb-trigger discharges a penetrating, snowy blanket of carbon dioxide gas . . . smothers an 8 qt gasoline fire in 9 sec. under official Underwriters'



Another example of Taylor Forge "know-how" that means extra value in WeldELLS

Rare specimen in Welding Tees—

● *When you think of a reducing tee you always picture it as reducing in the branch. But this one, for the peculiar purpose it serves, had to be made the other way around. It's a seamless, carbon-moly forging, five inches in the run with a seven-inch branch—an "increasing" tee, so to speak; one more example of those kinks that are found so abundantly in the Taylor Forge bag of tricks.*

The "know-how" acquired during many years of performing these special—often extremely difficult—manufacturing operations, has a mighty important bearing on our standard line of WeldELLS, Welding Tees and other Taylor Forge Welding Fittings.

It means that in developing WeldELLS we did not have to ask what kind of fitting is easiest to manufacture. Instead we asked what comprises the ideal fitting, and then, with every special facility and process at our command, made that conception a reality.

That is why WeldELLS have tangents . . . why they have extra reinforcement where service stresses are greatest . . . why they have such extremely accurate dimensions . . . why they have the features listed opposite . . . why, in short,

WeldELLS have everything

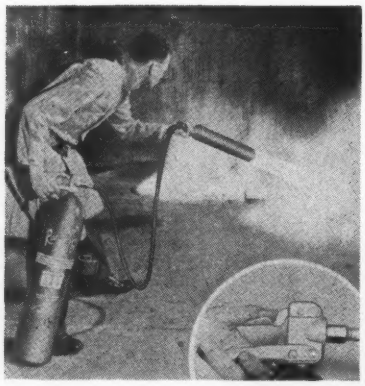
WeldELLS alone combine these features:

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

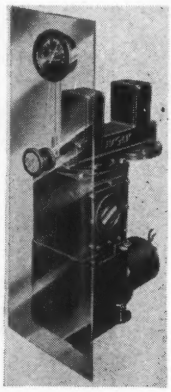
Laboratories fire tests. Release of the trigger automatically stops the flow, saves the remainder of the charge.

With no valves to twist, this simplified operation saves precious seconds



—reduces the chance of "operator's panic." Long-range hose and nozzle keeps the fire-fighter at a safe distance from the heat of the blaze—permits easy access to overhead, sidewall or engine compartment fires. Truck and wall brackets are provided for both vehicle and factory installations.

Pressure Regulator



HAGAN CORP., Hagan Bldg., Pittsburgh, has just announced its Type 2-SO regulator, designed to regulate the ratio of pressures or differential pressures.

Among construction features of the device are its wide operating range—from 0.10 in. water column to 5 psi—its spinning pilot valve, positive action, adjustable response, and its rugged simplicity.

The Type 2-SO regulator is principally used for such applications as the control of suction, pressure or flow ratio in any gas or air flow system where accurate control is required; control of fuel-air ratio in a wide variety of industrial heating furnaces where close regulation is necessary, and control of gas or air flow proportions in industrial processes where the end result is dependent on the maintenance of uniform or precisely adjustable conditions.

6-Inch Stroke Quintuplex Pumps

RATED AT 300 to 450 hp, depending upon its speed, a 6-in. stroke inverted quintuplex pump has been designed by the Aldrich Pump Co., Allentown, Pa. Plunger diameters range from 2 to 5¼ in. working pressures from 700 to 5000 psi and capacities from 60 to 850 gpm.

The Aldrich line of inverted quintuplex pumps now includes 6, 8 and 10 in. pumps requiring from 300 to 1000 hp. Write for new Data Sheet Number 67 which describes these pumps in detail and contains a Pump Selection Chart indicating the correct quintuplex pump for various conditions of pressure and capacity.

Non-Metallic 3-Way Valve

EMPLOYING a flexible molded synthetic rubber tube, encased within a bakelite body, this new Flex-tube three-way valve is designed for handling all types of fluids, including gases, chemicals and liquids. It is especially suited for hydraulic or pneumatic cylinder operation. Due to its unrestricted straight flow char-

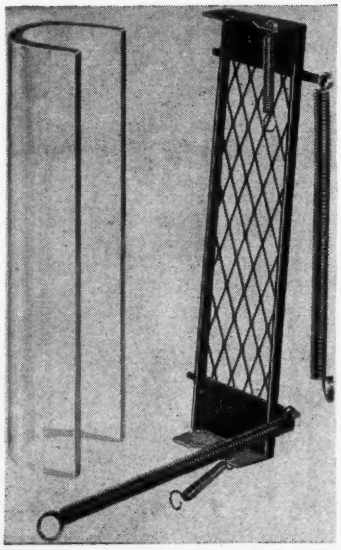
acteristic, this unit is most satisfactory for controlling viscous or solid-carrying fluids. Construction permits the handling of highly corrosive or erosive liquids or gases. Manual operation, by means of an over-center cam, opens and closes the ports at each half turn of the handwheel. A special self-locking feature assures positive tight shut-off over extended periods of time. Available in ⅛ and ¼ in. IPS, these new type valves are furnished for working pressures up to 250 lb, and maximum temperatures of 150 F. Announced by Grove Regulator Co., 65th & Hollis Sts., Oakland 8, Calif.

Gage Glass Protector

UNDER THE TRADE name Kleervu, a new type of gage glass protector has recently been developed by the Wright-Austin Co., 372 W. Woodbridge St., Detroit 26, Mich. This protective equipment consists of two simple parts—the metal frame, with four holding springs, and a quarter inch thick transparent "Nuglas" cover.

The installation of Kleervu takes but a couple of minutes and when installed it encloses the gage glass within a protective, transparent cover so that should the gage glass burst or explode, all flying broken glass is safely confined within this shatterproof enclosure.

The design is so carefully worked out that there is no loss of visibility—no blind spots and no corners. The glass-clear cover encircles the gage on three sides so that visibility is



clear from all directions. There is no interference to easy reading of the liquid level from front and sides.

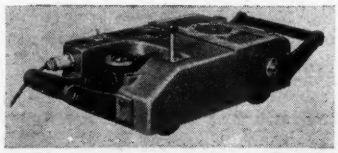
Back of the gage is a screened frame which holds the cover and provides an open vent area for escaping steam in case the gage glass breaks, thus avoiding any pressure build-up within the protector. These gage glass protectors are available in any desired length for tubular gage glasses on boilers, process tanks, chemical tanks, oil tanks, cooker and other installations.

Carriage for Welding Machines

THE LINDE AIR PRODUCTS CO., 30 E. 42nd St., New York, N. Y., has recently developed a new heavy-duty, straight-line machine known as the Oxweld-Unionmelt CM-37 machine carriage which can be used for carrying electric welding equipment, the CMA-21-B attachment for plate-edge preparation, single- or multiple-blowpipe setups for straight-line cutting, flame-hardening equipment, and the Oxweld C-45 Blowpipe for cutting extra-heavy sections.

The weight of the unit, without equipment as shown in the illustration, is 87 lb; thus making it readily movable from job to job. Its overall dimensions are 32 in. long, 12½ in. wide, and 9 in. high, plus 2⅞ in. for the forward-reverse lever.

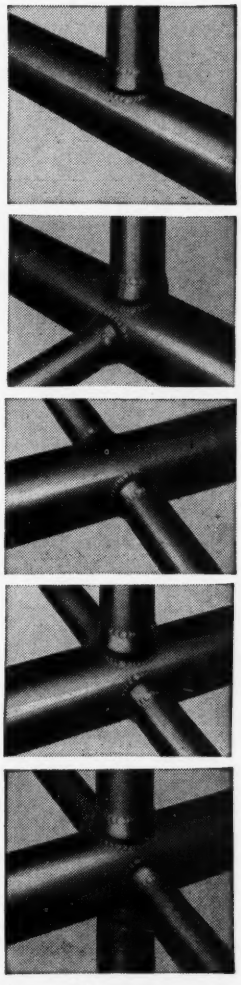
Power is supplied to the standard machine by a 110-v a-c unidirectional motor of ¼ rated electrical horsepower. Reversing is accomplished me-



chanically through gears. Machines are equipped with speed ranges of 2 to 50 in. per minute for general industrial use; and 7 to 210 in. per minute for use with the Unionmelt welding process. An electric speed-

WELDOLET FITTINGS

WeldOlets are available in three types—Welding Outlet, Threaded Outlet, and Socket Outlet



MAKE BRANCH PIPE OUTLET JOBS EASY

● Branch pipe outlet jobs can be done quickly, easily and permanently if you use WeldOlet Fittings. These modern fittings are designed expressly for their job. They require a minimum amount of space thus making possible joints like those illustrated.

In addition to their ease of installation, WeldOlet Fittings provide full pipe strength at the joint—eliminate possible weak spots at the branches. Flow conditions are improved too because of the funnel shaped inlet into the fittings. This funnel reduces turbulence permitting full capacity flow into the branch line.

Take advantage of the many features these modern fittings offer you on your next piping job. Write today for the new WeldOlet Catalog which contains complete information on why, where and how to use WeldOlet Fittings.

Forged Fittings Division

BONNEY FORGE & TOOL WORKS • 639 N. Meadow St., Allentown, Pa.

WELDOLETS
TRADE MARK REG. U. S. PAT. OFF.
PAT. IN U. S. & FOREIGN COUNTRIES
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET
For Welded Branch Pipe Outlets

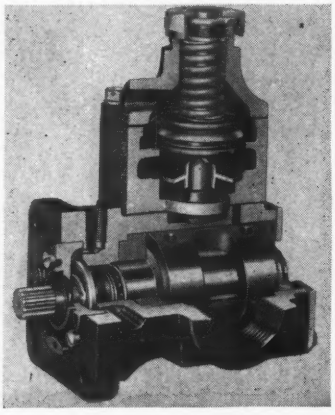
ometer is located in the machine cover so as to be within easy view of the operator at all times.

This carriage can be operated on a CM-21 track or, where accuracy of travel is not important, it can be operated on a standard 10-in., 25.4-lb I-beam. It also can be operated directly on the steel plate or other flat workpiece, if desired.

Twin-Valve Pump

DEVELOPMENT BY THE Candler-Hill Corp., Detroit, of a dual valve pump unit has just been announced.

The dual valve pump will have wide use in all postwar industry it was pointed out. It is designed to give accurate control under all conditions and to deliver a constant flow of fuel at almost constant pressure and vol-



ume. This performance is accomplished by a new development in relief valve design, for the dual valve, which incorporates two relief valves within its mechanism.

Working on a common guide pin, the dual valves balance each other and make possible regulation of pressure. The pump is now manufactured in two models with respective capacities of 830 and 1,600 gph at 2,500 rpm. The dual valves are said to insure that the discharge pressure will vary only minutely from the original setting.

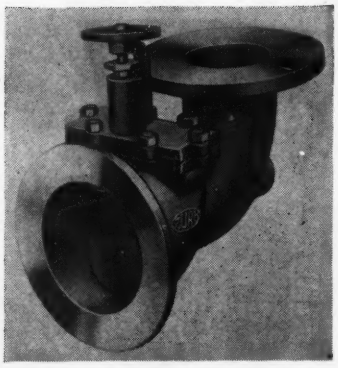
Discharge Check Valve

A DISCHARGE check valve has been designed by J. A. Zurn Mfg. Co., Erie, Penna., to give protection against the backsurge of discharge lines carrying steam, sludge, waste water and other waste liquids in gravity flow installations.

In order to assure non-fouling of the valve, these units have a removable swing check flap suspended from a full-floating pin fulcrum to insure positive full surface contact between ground face of flap and flap seat.

The knob in the center of the top surface of the swing check flap contacts the valve body roof at only one point when the swing check flap is wide open. This prevents the swing check flap from touching the sides of the valve body and is said to assure free operation of the swing check flap.

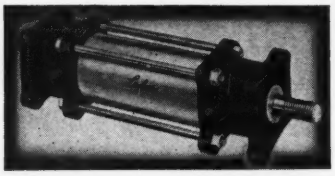
Discharge check valves may be operated with or without a manual control or with an extension shaft or flexible cable from an access box. The



units are hydrostatically tested. Flanges are 150 lb flat faced and blank or drilled as specified. They are available with 180 degree; 105 degree or 90 degree bodies made of cast bronze, steel, semi-steel, cast iron and alloyed metals for corrosion resistance.

Cylinder Design

A NEW DEVELOPMENT in design and construction of cylinders is announced by the Engineering Products Co., Los Angeles, Calif. In what is described as a new method of cylinder construction, a standardized cylinder has been produced for operation by air, oil, or water, which lends itself to almost universal mounting applications. At the same time, the cylinder is com-



pletely standardized, is manufactured in quantities, and is available off the shelf in an assortment of diameters, and stroke lengths that meet practically all requirements.

Corrosion Prevention by Steam Treatment

CORROSION OF steam lines and return condensate piping in industrial plants has been eliminated through the use of an organic chemical treatment proportioned into the steam, according to D. W. Haering & Co., Inc., 205 W. Wacker Drive, Chicago 6, Ill., who reports that pulp paper mills on the West Coast have installed H-O-H Model B Feeders to introduce a solution of organic glucosates into the steam flow ahead of the drying machines. The proportioning units, being activated by the steam flow through the header, automatically respond to any variation in steam consumption and guarantee accurate and continuous treatment dosages.

Corrosion is prevented through the formation of an inhibitor film on the metal surfaces of the system piping. The absorbed film is of molecular dimension and does not, according to the manufacturers, interfere with the transmission of heat through the pipe walls. The solution, dispersed in the vapor, is carried throughout the entire system and is present in the condensate at and after the condensation point thereby maintaining the inhibitor film intact.

Chemical and Mechanical Dryers

A NEW DRYER for removing moisture from air lines and gas lines is announced by The Gasflux Co., Mansfield, Ohio. Designated as the Gasflux 636 Series Dryer, this equipment was originally developed to remove moisture from generator acetylene used in conjunction with Gasflux units. However, the largest field of application appears to be for the removal of entrained moisture from air lines. Here the dryer has great flexibility because it is designed to use different drying media for accomplishing different degrees of moisture removal. It has also been found that this equipment is suitable for use in connection with welding and brazing operations where moisture conditions are causing difficulties.

The dryer is constructed with an outer shell of 6 in. OD seamless steel tubing and a removable inner shell or cartridge of rolled sheet metal having a perforated metal bottom. A cast bronze head with inlet and outlet openings is bolted to a flange welded to the outer shell. Incoming gas or air must first pass downward between the inner and outer shell, thus trapping out entrained moisture, and then passes upward through the drying medium.

Depending upon the drying efficiency that is required there is a choice of three drying media to be used in the cartridge. These are: Fiberglass, calcium chloride and activated alumina.

Fisk and Northwest Burn Oil

(Continued from page 116)

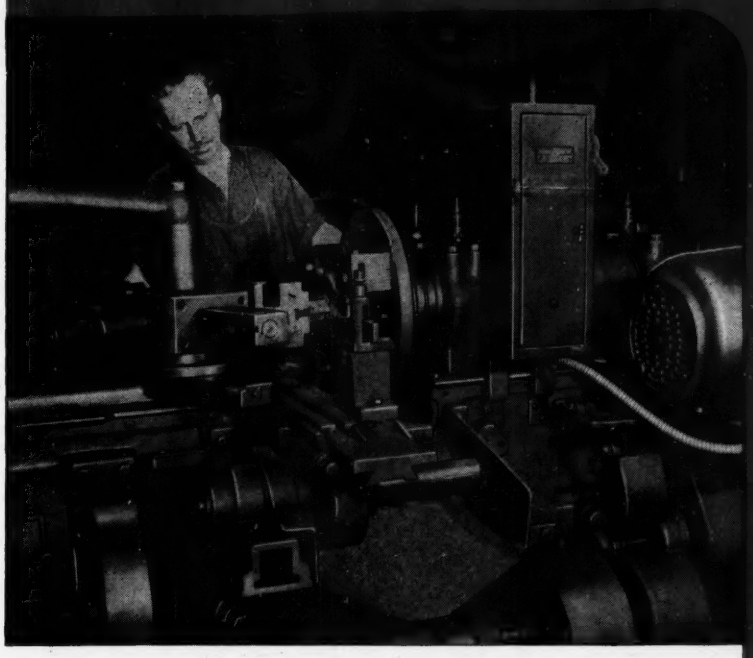
corners of the furnace. Schutte & Koerting oil strainers were installed on the suction side of the oil transfer pumps and on the discharge side of the main oil supply pumps.

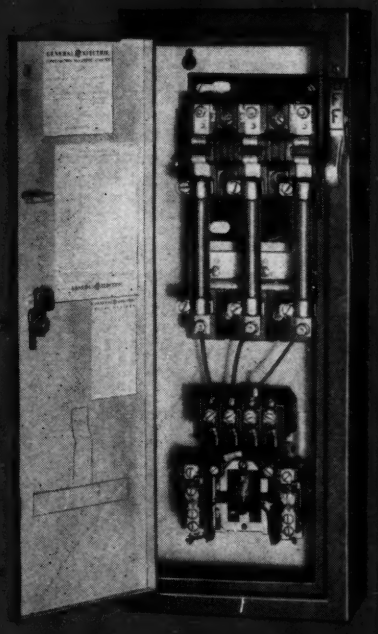
Burners at Northwest

On these three Northwest boilers, Enco mechanical-atomizing burners have been installed. The existing coal burners are located in the four corners of each furnace to provide tangential firing. An oil burner has been inserted in each of these. In this case also, there is no necessity for removing or making major changes in the coal burners, nor for making changes in the draft system. In this way, each of the three high-pressure boilers is being equipped with four oil burners with sufficient capacity to permit operation of the boilers at full steam output.

Regulation of oil supply to the boilers at both Fisk and Northwest is manually controlled. The furnaces in both stations being converted from coal to oil are of the wet bottom or slag-tap type, with water sealed slag tanks. No furnace changes were necessary.

300 G-E COMBINATION MOTOR STARTERS...





...give White Motor Company real protection...save time, money, too.

Magnetic starter and motor-circuit switch in *one* unit—G-E "combination" motor starters of this type give co-ordinated control to over 300 machines in the White Motor Company plant in Cleveland.

The starter shown above is installed on a lathe used in making water pumps. Others control drill presses, shapers, boring mills, grinders, and many other types of machines.

Here's Why the Combination Starter Was Chosen

- Fast-acting overload relays protect the motor controlled from overheating—and fuses protect it from damaging short circuits.
- Safety for operators is assured by interlocking doors. While the power is on, the door cannot be opened.
- Quick servicing and availability of repair parts is made possible by G.E.'s broad network of sales outlets.

Wide Field of Application

This motor company represents just one of the many different industries in which G-E combination starters are at work today. Why not give the advantages of these compact, time-saving starters to *your* plant. Our engineers will be glad to help with your application. Get in touch with our local office today. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

HOW YOU SAVE...

... TIME. Instead of buying two devices, you order and install only one. Mounting time is cut as much as 40 per cent.

... SPACE. Compact combination starters can be mounted in small unused places near to or remote from the operator.

... MONEY. The list price is slightly more than for two separate devices, but the difference is more than made up by savings in wire, conduit, and fittings.

MORE INFORMATION about combination starters is given in our bulletin GEA-3715A. Ask our local office for your copy.

GENERAL ELECTRIC

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Obituaries

Henry Kreisinger

HENRY KREISINGER, Director of Research for Combustion Engineering Co., died on the afternoon of May 7. One of the world's outstanding authorities on fuels and combustion, his death will be felt not only in engineering circles but in all related fields. The burning of pulverized coal was made possible largely through his inventiveness, and the many technical papers and bulletins which he prepared on the use of fuels and heat transmission in steam boilers added incalculable amounts to the total of engineering knowledge. The value of

these papers was recognized as early as 1907 when he was awarded the Chanute medal by the Western Society of Engineers for the best paper on mechanical engineering.

Born at Radnice, Bohemia, in 1876, Mr. Kreisinger came to the United States in 1891 and secured employment in various machine shops in and around Chicago thus earning the means to obtain a technical education. He entered the University of Illinois in 1900 and was graduated in 1904 with the degree of B.S. in Mechanical Engineering. He received his M.E. degree in 1906.

His early work in fuels was in connection with tests being made by the U. S. Geological Survey at St. Louis, Norfolk and Pittsburgh, from 1907 to 1910. For the next three years, 1910 to 1913, Mr. Kreisinger was fuels engineer for Clinchfield Fuel Co. At that time he was offered a position which promised him the opportunity to continue his research work and he joined the U. S. Bureau of Mines where he became supervising engineer in charge of fuel investigations.

He joined Combustion Engineering Co. in 1920 and devoted much of his time in the next few years to pioneer work in the development of pulverized coal firing and the application of water-cooled furnaces. The present widespread use of these developments, in large utility and industrial power plants, is largely traceable to his research. Prominent among these plants are the River Rouge Plant of the Ford Motor Co. and the Lakeside Plant at Milwaukee. In recent years, as Director of Research for Combustion Engineering Co., he had been responsible for extensive investigations of furnace temperatures and heat absorption.

Mr. Kreisinger was long a member of the American Society of Mechanical Engineers and the American Association for the Advancement of Science, and, besides the Chanute Medal, he had received the Percy Nicholls Award in 1943 for notable scientific achievement in the field of solid fuels.

Surviving are his wife, Ella M. Kreisinger, a son Robert, and two daughters, Dr. Elizabeth C. Kreisinger and Mrs. Arthur Selvey.

W. C. Dickerman

WILLIAM CARTER DICKERMAN, 71, who retired in December as chairman of the Board of Directors of the American Locomotive Co., died recently.

Mr. Dickerman was president of the company from 1929 until 1940 when he was elected chairman of the Board; following his resignation from that position he had remained as a member of the Executive Committee and of the Board. He was also a member of the Executive Committee of the American Car & Foundry Co. and was a director of many other corporations including General Electric Co., Superheater Co., International General Electric Co.

Upon graduation from Lehigh University in 1896 he joined the Milton Car Works, Milton, Pa. There he served successively in the auditing, purchasing and engineering departments. In 1899, upon formation of the American Car & Foundry Co., of which the Milton Company became a part, he was appointed assistant manager of the Milton district of that company. Later he was appointed vice president.

Among his many memberships were those in the American Institute of Mining and Metallurgical Engineers and the American Society of Mechanical Engineers. He was recently elevated to a Fellowship in the latter organization.

Mr. Dickerman is survived by his wife, Alice; a son, William; three daughters, Mrs. Orson L. St. John; Mrs. James Oliver Brown; Mrs. Ernest Lee Jahncke, Jr.; and two sisters, Mrs. Howard Williams and Mrs. Guido C. Vogel.

Clyde R. Place

CLYDE R. PLACE, 68, consulting engineer, whose engineering organization played an important part in the construction of World War II camps and training facilities, died recently.

A graduate of the Massachusetts Institute of Technology and a specialist in engineering design, Mr. Place was called upon to design the mechanical, electrical, elevator, air conditioning and power plant systems for many famous buildings. Among these were Rockefeller Center, Grand Central Terminal and many others.

He is survived by his wife, Mabelle; two daughters, Mrs. H. Ware Knudson and Mrs. Richard Allan Mason, both of New Canaan, Conn.; and a son, John, of Williams College.

James Williams

JAMES WILLIAMS, shop superintendent of The Terry Steam Turbine Co., died recently. Mr. Williams was born in Manchester, England, and his first job was with Galloways, in his home town. He left there to work for the British Westinghouse Co. at Trafford Park, England. Later, Mr. Williams came to the United States and was employed by Westinghouse Electric Corp. in this country. During this period of employment he spent over a year in Japan on company business.

In 1911, just thirty-five years ago, he was employed by The Terry Steam Turbine Co. and shortly thereafter was made shop superintendent, the position he held until his death.

Mr. Williams was a member of the ASME and the Hartford Engineers Club.

NEWS *from* THE FIELD

Potts Medal to Moss

DR. SANFORD A. MOSS, of Lynn, Mass., has received the Potts Medal of The Franklin Institute, according to an announcement recently by Dr. Henry Butler Allen, secretary and director of the Institute. Dr. Moss, consulting engineer for the General Electric Co., receives the award "in consideration of the extreme value of his work in making a turbosupercharger a successful and reliable part of an internal combustion engine."

Dr. Moss was born in San Francisco, Calif., in 1872. At the age of 16, he was apprenticed there as a machinist in a shop making air compressors. After completing his apprenticeship, he studied mechanical engineering at the University of California, receiving his B.S. degree in 1896 and his M.S. in 1900.

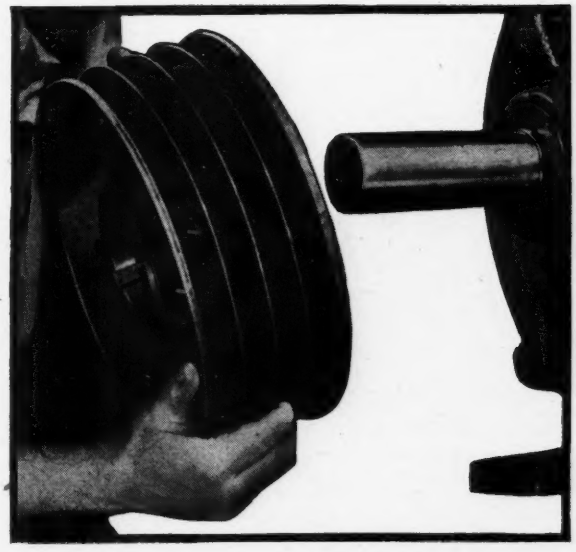
He continued his work on the gas turbine first in Schenectady and then in West Lynn, Mass. Materials then available, however, could not resist the high temperatures, but, in the course of this work, Dr. Moss developed centrifugal compressors which found wide use in the metal industries.

Westerberg Joins BCR

BITUMINOUS COAL RESEARCH, INC., today announced the addition of Carl S. Westerberg to its Pittsburgh office staff. The appointment is effective at once. Mr. Westerberg succeeds Ralph H. Hopp, who resigned last year.

Mr. Westerberg's experience includes coal analysis work, design of a

"MAGIC-GRIP" SHEAVE



GOES ON EASY

There's plenty of clearance in the bushing of the patented "Magic-Grip" sheave. It slips easily on even oversize shafts . . . never requires filing, reaming or hammering. Think of the time and money *that* can save!

Sheave and bushing come completely assembled . . . one precision-made unit ready to mount. Slide it on the shaft to exact alignment. Then — tighten three cap screws with the handy wrench furnished. That's all! Any one can do the job—quickly, easily, accurately.

— GRIPS TIGHT

The sheave is locked on the shaft with the powerful grip of a vise. No slip, no backlash or wobble. Yet it can be removed as easily as it goes on.

"Magic-Grip" sheaves save time and money the first time they are installed . . . are indispensable for applications requiring frequent sheave changes. Yet they cost no more than standard sheaves of comparable heavy-duty construction.

YOUR V-BELT DRIVE HEADQUARTERS

Call your nearest Allis-Chalmers office or dealer for TEXROPE "Magic-Grip" sheaves, Texsteel, Texdrive and Vari-Pitch sheaves, Speed Changers and famous TEXROPE Super-7 V-Belts. Full range of types and sizes. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 2035

ALLIS CHALMERS TEXROPE V-BELT DRIVES

HEAR THE BOSTON "POPS": *Every Saturday Evening, American Broadcasting Co.*

coal control laboratory, training coal technicians, studies in coal utilization, fuel engineering, investigations relative to low-temperature coking processes, bulletins for use by coal salesmen and preparation of technical articles.

Willow Run Has Huge Utility Program

THE WATER purification center of the huge automobile plant operated by Kaiser-Frazer Corp. and Graham-Paige Motors Corp. has been adjusted for peacetime manufacture and is now capable of supplying 6,000,000 gal of water per day to the main manufacturing building 11,833 ft away. Nicholas Herda, superintendent of utilities, believes that the modern equipment of the water purification center of the former bomber plant is superior to that maintained by a city whose population approximates 40,000.

Herda says that water taken from three wells, with an average depth of 84 ft, is piped to treatment units at the rate of 4,000 gpm. Average hardness of well water is 300 ppm. After treatment and filtration the water hardness drops to 62 ppm.

ASHVE Research Gets New Home

THE AMERICAN SOCIETY of Heating and Ventilating Engineers has purchased property at 7218 Euclid Avenue, Cleveland, to provide adequate research facilities for serving the entire heating, ventilating and air conditioning industry as well as the associated industries, according to a recent announcement. The move to the new home for the Society's Research Laboratory was effective April 1st.

The property consists of a substantial dwelling with a large two-story brick auditorium type building attached. Its location on one of Cleveland's main traffic arteries makes the laboratory accessible from the center of the city and from east side railroad stations.

The brick building, which is 58 ft by 125 ft on its foundation houses the laboratory proper. At grade level are three large rooms with 11 ft ceilings and numerous small service rooms totaling about 5300 sq ft which provide excellent research, workshop and storage facilities. The only basement space is that provided for the heating plant.

Diesel Engineers Meet in Milwaukee

THE 18TH National Oil and Gas Power Conference, sponsored by the Oil and Gas Power Division, ASME, will be held at the Hotel Schroeder, Milwaukee, Wis., June 12-15. Postponed from last year because of the government ban, the meeting has had an additional year to gain momentum and the result is a program packed with sessions of strong current interest.

There will be a total of seven technical sessions, arranged to leave afternoons free for the many worthwhile inspection trips that can be made in an industrial center such as Milwaukee. The technical program gets under way Wednesday afternoon, following registration in the morning. There follow a session on Thursday morning, two each on Friday and Saturday mornings, and one Friday evening.

Toledo Smoke Story Told

THE FORMAL presentation of the survey of heating and power plants in the city of Toledo, Ohio, which was made by the Coal Producers Committee for Smoke Abatement, was made before the city council recently. In all, the engineers of the committee surveyed 180 plants in Toledo and in the summary of their findings the report says:

"Much of the smoke in Toledo can be attributed to carelessness or because most firemen have no method of knowing when they are making smoke, and to the fact that there has been no continuous smoke-abatement effort in Toledo.

"Some of the equipment surveyed was in extremely bad condition and some of it was being very poorly operated, but most of it was in reasonably good condition.

"The fact that Toledo is located on flat ground and has no 'basin' to hold fog or smoke over the city, helps very materially in keeping its atmosphere relatively clean. Toledo is particularly fortunate in this respect as compared to most of the other middle-western cities. The prevailing wind in Toledo is in the direction of the northeast or east, toward the lake, which tends to get rid of most of the smoke and fly ash as it is made. Only those on the leeward side of an industrial or commercial plant, which throws out smoke, fly ash, dust, or fumes, are likely to feel the full effect of atmospheric pollution."

Mathieson's New Plant

IN LINE with its program of expanding production and research facilities, The Mathieson Alkali Works, manufacturer of a number of heavy chemicals and chemical specialties, is about to build a new pilot plant at Niagara Falls, N. Y.

The structural steel for the building is on hand and construction will get under way as soon as real estate negotiations are concluded.

COMING EVENTS

National Oil and Gas Power Conference — 18th conference sponsored by ASME; to be held June 12 to 15, at Hotel Schroeder, Milwaukee.

American Society of Mechanical Engineers—1946 Annual Meeting; to be held in Detroit, June 17 to 20, with headquarters at the Statler Hotel.

Smoke Prevention Assn. of America—Annual meeting of the Association; to be held at the Hotel Nicollet in Minneapolis, June 23 to 26, inclusive.

Society for Experimental Stress Analysis—Spring meeting of SESA; to be held June 24 to 26 at The Hotel Statler, Buffalo, N. Y.

American Institute of Electrical Engineers—1946 summer convention of the AIEE; to be held June 24 to 28, at the Statler Hotel, Detroit.

American Society for Testing Materials—49th annual meeting of the ASTM; to be held June 24 to 28, at the Hotel Statler in Buffalo.

American Society of Civil Engineers—1946 Summer Meeting; to be held in Spokane, Wash., July 17-20.

National Assn. of Power Engineers—National Power Show; to be held in Cleveland at the Cleveland Public Auditorium, August 19 to 22, inclusive.

National Assn. of Power Engineers—Annual convention of the NAPE; to be held in Cleveland at the Public Auditorium, August 19 to 22, inclusive.

American Chemical Society—National Chemical Exposition, sponsored by the Chicago Section of the Society; to be held September 10 to 14, in the Chicago Coliseum.

National Chemical Exposition—Biennial exposition, sponsored by Chicago Section of American Chemical Society; to be held September 10 to 14 in Chicago Coliseum.

Instrument Society of America—"Instrumentation for Tomorrow" exhibit; to be held in Pittsburgh at the Hotel Wm. Penn, September 16 to 20.

American Society of Mechanical Engineers—Instruments and Regulators Committee; meeting to be held in Pittsburgh at the Hotel Wm. Penn, September 16 to 20.

National Electronic Conference—Conference sponsored by Illinois Institute of Technology, Northwestern University and the Chicago Sections of AIEE and IRE; to be held at the Edgewater Beach Hotel in Chicago, October 3 to 5.

American Society of Civil Engineers—1946 Fall Meeting; to be held in Kansas City, Mo., October 16-19.

American Welding Society—1946 annual meeting to be held in New York City, October 24; headquarters not yet announced.

Seventh Annual Water Conference—Sponsored by the Engineers Society of Western Pennsylvania; to be held in Pittsburgh October 28 to 30, with headquarters at the Hotel William Penn.

American Welding Society—1946 annual meeting (reassembly) to be held in Atlantic City, November 17 to 22; headquarters not yet announced.

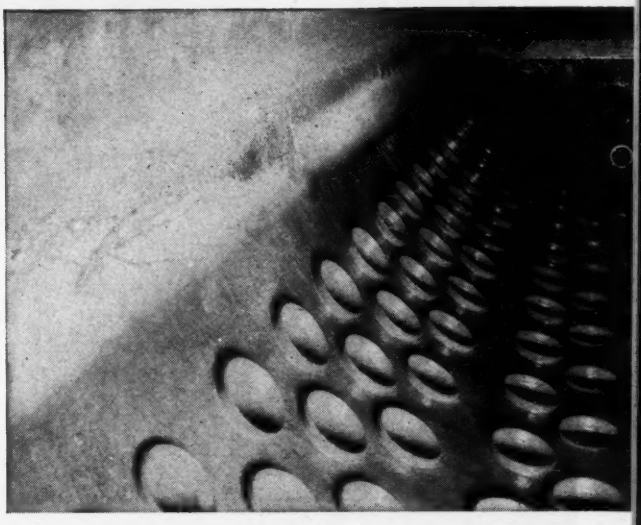
National Metal Congress and Exposition—To be held in Atlantic City, November 17 to 22, headquarters not yet announced.

Refrigeration, Air Conditioning Show—Sponsored by Refrigeration Equipment Manufacturers Assn.; to be held in Cleveland, October 29 to November 1, in the Public Auditorium.

Heating and Ventilating Exposition—7th International Heating and Ventilating Exposition; to be held January 27 to 31 in Cleveland at Lakeside Hall.

DOWELL

this boiler was thoroughly cleaned the chemical way



Power plant engineers—men who are responsible for *efficient operation* of heat-exchange equipment in leading industries have welcomed the Dowell chemical method of removing scale and sludge.

Plants everywhere are learning that the Dowell method is safe, economical, rapid—and thorough.

Dowell specialists do the entire job. They pre-inspect the equipment to be cleaned. They chemically analyze samples of deposits found in *your* plant. And after this careful preparation, they bring with them the proper chemicals and adequate equipment to perform completely every stage of the treatment—to insure effective removal of the insulating deposits.

For complete details, call the nearest Dowell office for a free estimate. Ask for your copy of "More Power to America's Industry"—new color booklet which explains and illustrates Dowell's thorough chemical cleaning service.

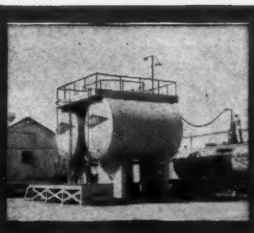
DOWELL INCORPORATED • TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

New York • Philadelphia • Baltimore • Buffalo • Cleveland • Cincinnati
Chicago • Detroit • St. Louis • Houston • Kansas City • Wichita
Mt. Pleasant, Michigan • Salem, Illinois
Long Beach, Casper: Dowell Affiliate—International Cementers, Inc.

SPECIALISTS IN CHEMICAL CLEANING SERVICE

Dowell's organization of industrial engineers are backed by the complete research and technical facilities of The Dow Chemical Company.

Dowell's fleet of modern, well-equipped trucks—scientifically designed. Treating stations and chemical warehouses conveniently located.

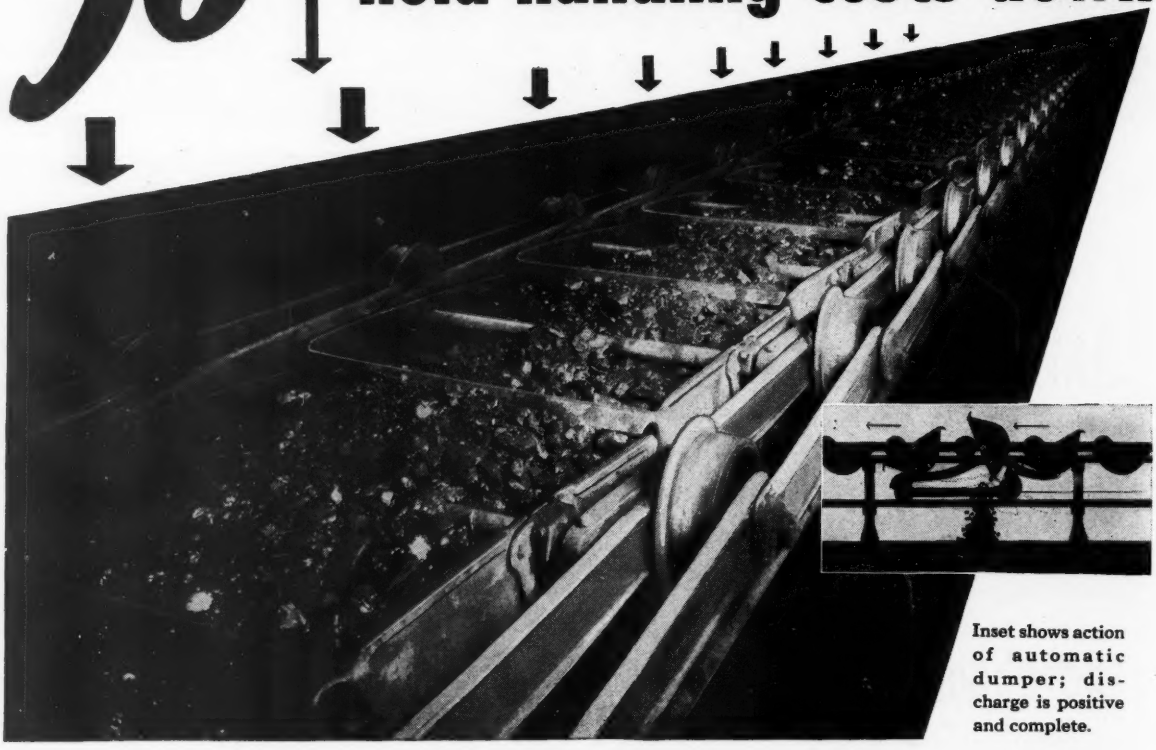


Dowell-growing solvents are "tailor-made" to fit each job. All ingredients are of the highest quality, chosen for best results in your plant.

DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE

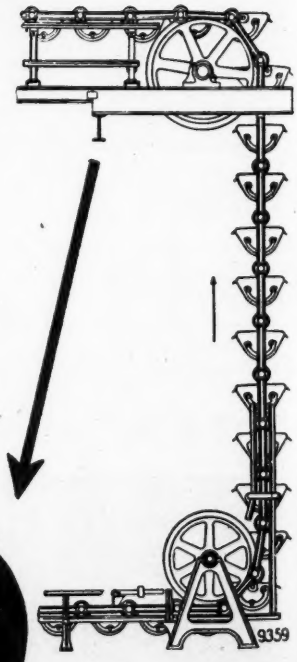
50 miles of PECK CARRIER hold handling costs down



Inset shows action of automatic dumper; discharge is positive and complete.

● In its field, the Peck overlapping, pivoted-bucket carrier offers the lowest cost and most dependable type of conveying . . . proved by more than fifty miles of installations handling coal, ashes and other materials. Many Peck carrier units have been in continuous use twenty years and longer, attesting to the dependability, long life and economy of this equipment.

Since the buckets at all times maintain their carrying position by gravity, a single carrier can transport coal or ashes horizontally, vertically and again horizontally, or on any desired path. The material is *carried* in buckets, supported by rollers of large diameter in connection with two strands of specially constructed rolling chain; therefore friction and power requirements are reduced to a minimum. The material can be discharged at a number of points, merely by pre-setting the dumper which is used for engaging the cams on both sides of buckets. Each bucket rights itself to normal carrying position, and the dumping will continue automatically until moved to a new location. Can be used in cramped space. Standardization of individual units and assemblies assures interchangeability and makes possible combinations practically limitless. For details write for Book No. 1720.



LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

10,282

LINK BELT

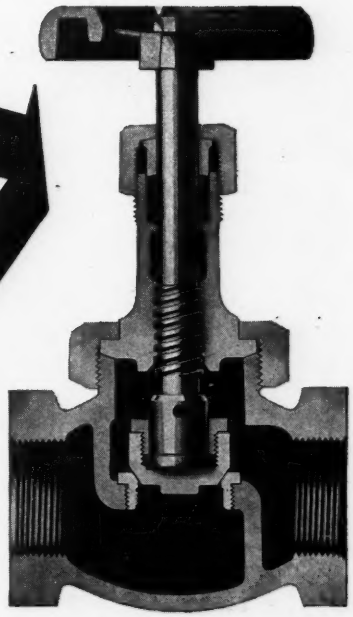
COAL AND ASHES HANDLING EQUIPMENT

Every feature you want in a

BRONZE GLOBE VALVE

with Full-way Disc...

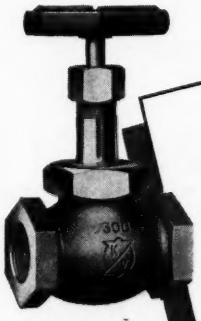
is in this KENNEDY DESIGN



You can use this Kennedy design on high temperature steam, water, oil or gas lines with full confidence that it will give complete satisfaction.

Notice the sturdy construction of every part . . . the renewable disc and seat ring . . . the full-way disc area . . . the ample pipe-end clearances and packing space . . . the true union joint made by the body-bonnet connection . . . and the many other details that provide *what you want* in a full-way disc globe or angle valve.

These valves are furnished in a full range of sizes for 200-lb. and 300-lb. steam pressure at 550° F. and for cold water, oil or gas pressures up to 600-lb. Complete description, specifications, dimensions and prices are given in the 240-page Kennedy Catalog which will be sent on request.



YOU WANT THESE VALVE FEATURES
. . . you'll find them in this KENNEDY design

1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
2. **Easy Operation . . .** Stem and stem contact surfaces are accurately threaded. Deep stuffing boxes permit tightness without undue pressure on packing. Large handwheel gives firm, comfortable grip.
3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

THE KENNEDY VALVE MFG. CO.
Elmira, New York

KV-114

KENNEDY *valves - pipe fittings - fire hydrants*

AVOID COSTLY GASKET FAILURE

ARMY E NAVY

WITH "Flexitallic"
REG. U. S. PAT. OFFICE

SCIENTIFIC MADE-TO-MEASURE DESIGN

Style C-G..COMPRESSION RING TYPE

Safe, sure sealing members for raised-face, smooth-face, Van Stone or Cranelap fittings.

Style D
SELF-CENTERING TYPE
A continuation of the spiral metal winding serves as a perfect guide to proper centering of the gasket.

In addition to the types illustrated, Flexitallic Gaskets are available in styles and sizes for practically every pipe flange and pressure vessel requirement.

Whether your sealing problem involves high-pressures, high-temperatures, shock or vibration, corrosion, or chemicals, Flexitallic Spiral-Wound Gaskets can solve it. Moreover, the slightly higher cost resulting from engineering gaskets specifically to the application is more than repaid by easier installation and elimination of costly maintenance.

Exclusive high-speed precision methods permit Flexitallic Gaskets to be wound to more exacting, scientifically-determined tolerances than any in the industry. Exclusive construction features evolved through more than a third of a century of spiral-wound gasket specialization offer absolute assurance of maximum strength with minimum seating area *plus* the all-essential resiliency to meet changing line conditions. Catalog on request. Better yet, send details of your application for a specific recommendation by Flexitallic engineers.

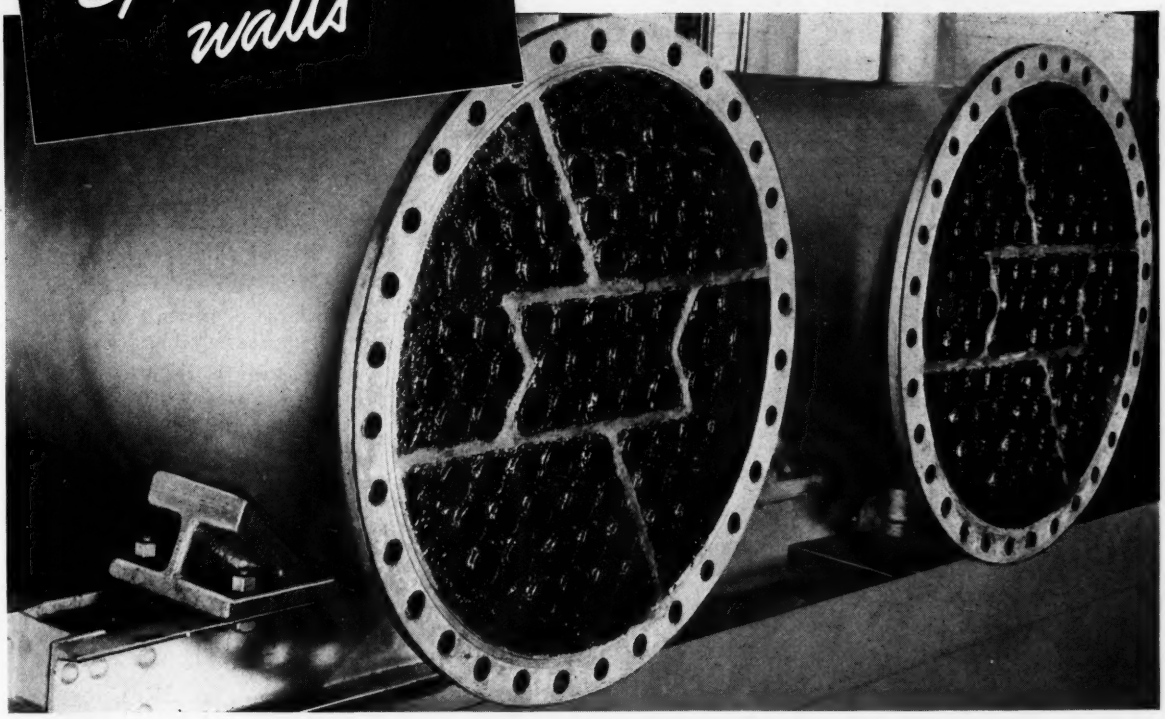
FLEXITALLIC GASKET CO.
8th & BAILEY STS. · CAMDEN, N. J.

THE ANSWER TO 1001 DIFFICULT GASKET PROBLEMS

HEAT-PROOF **SHOCK-PROOF** **LEAK-PROOF**

ANY TEMPERATURE – ANY PRESSURE (INCLUDING 2500 LBS. A.S.A. SERIES)

"Sprayed-on" walls between metal and water



APEXIOR NUMBER 3 is a durable, protective coating made of 100% asphalts dissolved in a completely volatile solvent. Applied to metal surfaces, it dries to a shiny-black film, impervious to fresh or salt water at all temperatures under 125°F.

In condenser tubes, such as those shown above, or vertical, APEXIOR NUMBER 3 makes cleaning easier, because its chemically inert surface prevents the tight bonding of scale. Walled against all outside contact, the metal surface is completely isolated from corrosive action. New metal is *kept* new — old metal is preserved from further deterioration, even when corrosion has made considerable headway.

To apply APEXIOR NUMBER 3, first clean the surface thoroughly, down to the bare metal, leaving no trace of oil or other moisture. For tube interiors and other hard-to-get-at spots, special spray equipment is supplied; a hand brush is used for accessible areas.

Takes the Wear

Besides its effectiveness in condensers and cooling equipment, the tough, wear-resistant character of APEXIOR NUMBER 3 offers lasting protection in many other instances where rapid cold-water flow occurs — for example, in marine applications such as propeller and rudder areas. Being non-conducting, it counteracts corrosive electrolysis between different metals.

Non-Toxic

APEXIOR NUMBER 3 checks corrosion in all cold-water storage or cooling tanks. It is safe for drinking-water contact, having no toxic effect and imparting no taste to the water.

APEXIOR NUMBER 3 offers enduring, economical insurance against corrosion — proved by countless successful applications on land and sea for over a quarter of a century. Your own cold-water handling equipment needs this positive protection for longer life and reduced maintenance . . . the coupon below will bring all the facts. The Dampney Company of America, Hyde Park, Boston 36, Mass.

Two new high-temperature Dampney coatings are Thur-Ma-Lox Number 7 Black (1600°F.) and Thur-Ma-Lox Number 10 Aluminum (1200°F.). Properly applied, they provide lasting protection to dry metal surfaces subjected to the extreme temperatures indicated.

APEXIOR

Keeps new metal new . . . Gives old metal new life

DAMPNEY

THE DAMPNEY COMPANY OF AMERICA
1262 River Street
Hyde Park, Boston 36, Mass.
Please send free Bulletin 1290

Name.....

Company.....

Address.....

.....

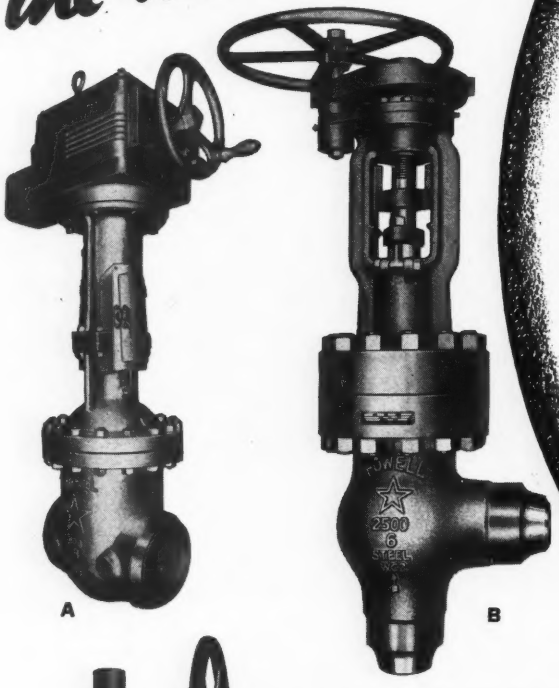
For assured performance, the valve must suit the service!

For certain services, Iron Valves are fully adequate. In others, Bronze Valves are especially suitable. And, in many installations, Steel Valves are definitely required. Moreover, the modern trend toward higher and higher pressures and temperatures in power installations has imposed many new demands for special flow control equipment. As always through 100 years of making valves for industry, Powell Engineers have met every challenge.

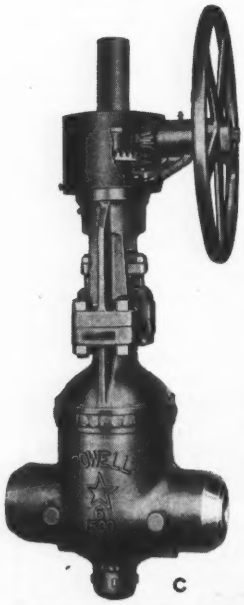
Today, in addition to complete lines of Bronze and Iron Valves of every required type and size and Cast Steel Valves of all types in pressure classes from 150 to 2500 pounds, Powell can furnish valves designed to meet special requirements of the modern power plant. A few are shown here.

In writing for catalogs, kindly state your requirements. Powell Engineers will be glad to help you select the correct valves to suit the service.

The Wm. Powell Co., Cincinnati 22, Ohio



A B



C

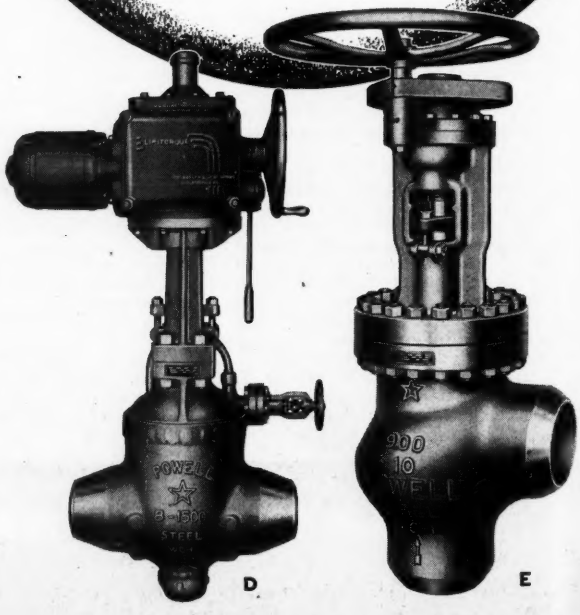
(A) Class 300 Pound, 8-inch Cast Alloy Steel Gate Valve, with welding ends and bolted flanged bonnet. Equipped with top-mounted electric motor operator for quick, positive opening and closing by remote control.

(B) Class 2500 pound, 6-inch Cast Alloy Steel Angle Valve with welding ends, outside screw rising stem and bolted flanged yoke. Spur gear operated. Can be equipped with bevel gears or electric motor operator.

(C) Class 1500 pound, 6-inch Cast Alloy Steel Gate Valve with welding ends and welded bonnet. Bevel gear operated.

(D) Class 1500 pound, 8-inch Cast Alloy Steel Gate Valve with welding ends, welded bonnet and special by-pass. Top-mounted electric motor operator provides quick, positive opening and closing.

(E) Class 900 pound, 10-inch Cast Alloy Steel Non-return Angle Valve, with welding ends. Spur gear operated. Powell Non-return valves are available also with bevel gear, toggle or motor operation.



D E

POWELL VALVES

Stop This
Waste
for
GREATER FREEDOM
FROM LEAKS
INSTALL LADISH
Forged Steel Fittings
Drop Forged fittings provide longer life and increased endurance. Greater metal soundness, finer grain structure and increased strength result from the high impact pressures inherent in the Drop Forging process.
Added resistance to the shocks, strains and stresses . . . imposed by pressure, temperature, vibration, expansion and contraction . . . is obtained by using forged steel fittings. Ladish Controlled Quality Forged Steel Fittings provide additional advantages of thorough metallurgical control and close inspection of physical dimensions.
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"ABSOLUTE Absence of Sludge ..."

since using Tycol turbine oils"

"Repair bills slashed 30% . . . Ten years without an oil change . . . Bearings show no signs of wear . . . Oil consumption cut in half . . ."

These results are typical of the unusual performance achieved with Tycol Turbine Oils. Refined by a special process, these modern lubricants stand up under the toughest service conditions . . . retain their original characteristics.

Call your nearest Tide Water Associated Office today for full information about the time- and money-saving advantages of Tycol Turbine Oils. Rust inhibited *Tycol RIO Turbine Oils* are also available for operations where corrosion is a factor.

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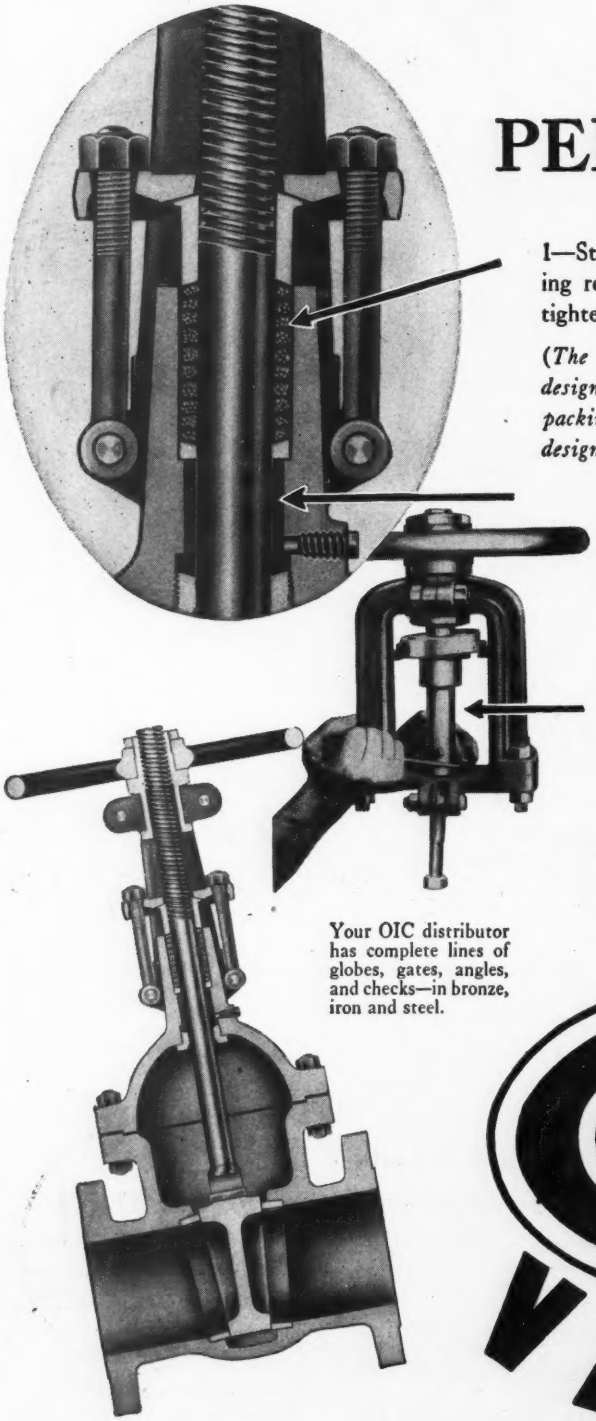
TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

How OIC *Improves* VALVE PERFORMANCE



1—Stuffing box is especially designed so that packing retains life and resilience as the packing nut is tightened from time to time.

(*The equalized compression provided by the special design of OIC packing glands can lengthen the life of packing as much as 10 to 20 per cent compared to other designs.*)

2—For installations where heat is an enemy of packing life a condensing chamber below the stuffing box minimizes heat deterioration.

(*Condensing chamber design is a special feature of OIC Valves for applications involving high temperatures.*)

3—Simplified repacking eliminates lost motion, reduces time required for repacking when needed.

(*The LIFT-LOK, exclusive with OIC, is a self-contained feature which automatically holds gland and follower out of the way while the valve is repacked.*)

Your OIC distributor has complete lines of globes, gates, angles, and checks—in bronze, iron and steel.

OIC VALVES

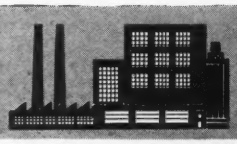
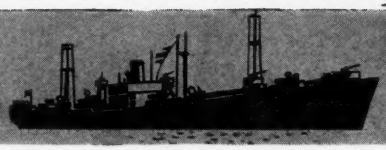
THE OHIO INJECTOR COMPANY, WADSWORTH, OHIO

NOW! NOTHING INSIDE OF BUTT WELDED JOINTS

Exaggerated, yes; we're merely trying to emphasize the effect of backing rings on flow in butt welded pipelines. And if the ends of the pipe lengths are recessed to lessen these "humps," pipe strength is sacrificed. And if no rings are used, protrusions of weld metal produce the same "humps." Again, but they are rough-jagged, except where the patented Westport Method of Controlled, Two Stage Welding is used. This produces a pipe contour, smoother on the inside than on the outside, with maximum bondage and strength. . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today. And remember, while your shop pre-fabricated piping can be made with any type of joint, we believe you'll prefer and specify the Westport, after you read our bulletin.

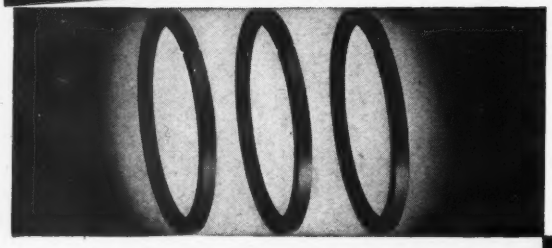
"MADE WITHOUT BACKING RINGS BY THE MITCHELL-WESTPORT METHOD"

MITCHELL

On Land  *or Sea* 

SEA-RO has the RIGHT PACKING FOR EVERY PUMP

Next time you repack a pump, see that the right packing is used and you'll be money ahead. Investigate the advantages of Sea-Ro packing. You'll find it stands up under high temperature and high pressure, and has many exceptional features that make it superior in wearing and performance qualities.

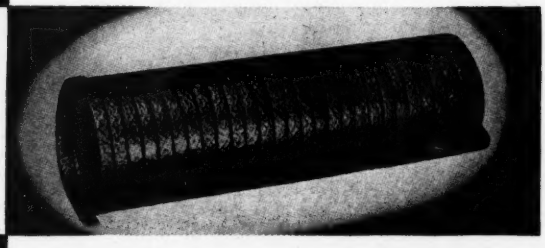


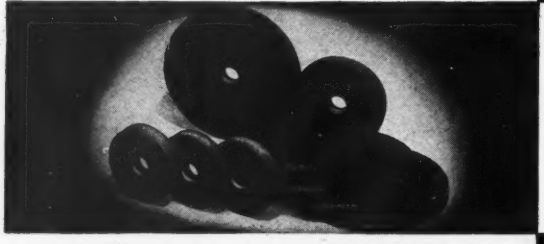
"GRAPHITIZED" Pump Plunger Rings

Style No. 528. Strong, laminated phenolic composition enables these rings to resist high temperature and high pressure. "Floating type." Long wearing, light-weight, minimum friction. Unaffected by most solvents, oil and reagents.

"SUPERHEAT" PACKING

Style No. 503 designed for long trouble-free service under superheat steam. The core, a flexible plastic metallic material is anti-frictional, self-lubricating and heat proof. Contains no rubber, therefore non-vulcanizing.



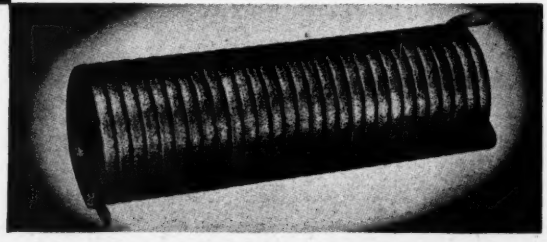


ALL-PURPOSE Pump Valves

Style No. 535. Impervious to decomposition, warping or chemical action, these laminated phenolic composition valves give years of service and can be resurfaced for extra duty under toughest conditions.

STANDARD NEK-SEAL Packing

Style No. 501, ideal for centrifugal and reciprocating pumps. Once installed it forms a fine bearing surface. Wear on rods is reduced to minimum because of lubricating qualities in packing. A practically permanent packing when properly installed.



Send for new CATALOGUE giving full description of these and other SEA-RO packing products.

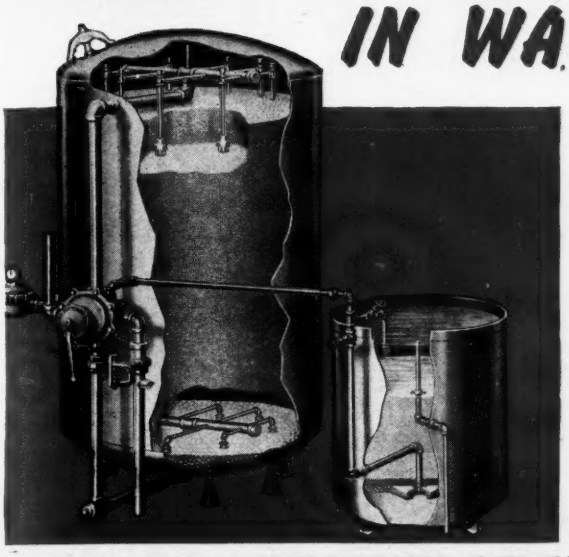
SEA-RO

PUMP PLUNGER RINGS
NEK-SEAL PACKING

SEA-RO PACKING CO. • WOOD-RIDGE, NEW JERSEY

Agents:
WEISE ENG. & EQUIP. CO. . . . . 172 HIGH STREET, BOSTON, MASS.
VICTORY SUPPLY & MFG. CO. . . 273 WEST 7th STREET, SAN PEDRO, CALIF.
CORDES BROS. . . . . 200 DAVIS STREET, SAN FRANCISCO, CALIF.

WHO OFFERS MOST IN WATER SOFTENING?

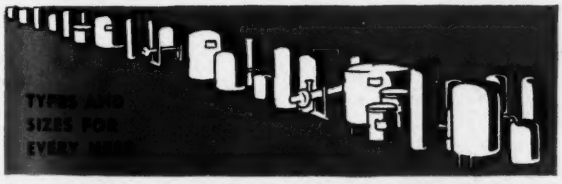


First consider these unmatched features of the Elgin Water Softener . . . . .

1. **Delivers up to 44% More Soft Water**—than other zeolite softeners of the same size.
2. **Lower first cost**—on basis of cost per thousand gallons delivered.
3. **Lower operating cost**—as a result of reduced salt and wash water consumption achieved by improved distributing and collecting arrangement.
4. **Higher efficiency**—because zeolite is kept clean and active, producing more zero-soft water per pound of salt used.
5. **Less Maintenance**—proved by surveys showing fewer repairs, less replacements, and prevention of zeolite loss.
6. **Longer life**—a result of more efficient distribution, collection and regulation of water and brine which keeps zeolite clean and adds years to service life.
7. **Less space required**—other softeners must be as much as 50% larger to give equal capacity.

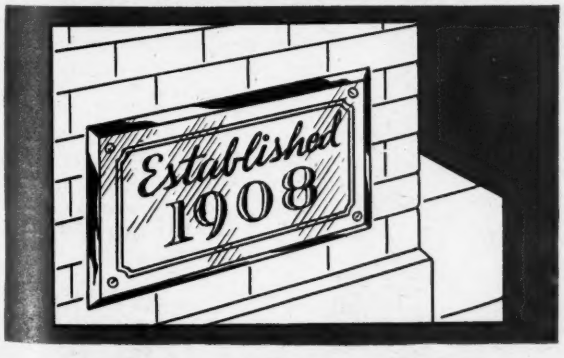
—then consider Elgin nation wide service

In the opinion of hundreds of users, the features of the Elgin Zeolite Softener listed above make it the most effective equipment of this type ever developed. However, no single piece of equipment offers a solution to all water conditioning needs. Therefore, Elgin engineering service is as important as Elgin equipment. Elgin district engineers are located in principal cities from coast to coast. They are specialists with practical operating experience who will assist you in providing economical water conditioning engineered to your particular requirements.



—and the scope of Elgin equipment

With water softeners of every type and size from which to choose, Elgin is in a position to provide equipment specifically designed to your needs. Incredible though it may seem, Elgin is in a position to build over 5,000 combinations of types and sizes of water conditioning equipment.



—Above all, Elgin Experience . . . . .

At your service is knowledge gained in over 38 years of research and engineering experience in which Elgin has pioneered major improvements in the science of water softening and conditioning. In our research department alone, a large staff of engineers and chemists devote their entire time to the solution of special water problems. They maintain one of the country's most complete files of water analyses. Any new analytical work required in making recommendations is performed without charge.

Yes, from any standpoint — product, engineering service, experience — Elgin is the choice of leaders in every field.

NEW BULLETIN 607 gives all the facts. Ask for it.

Let an Elgin Engineer Help You Plan

ELGIN SOFTENER CORPORATION

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

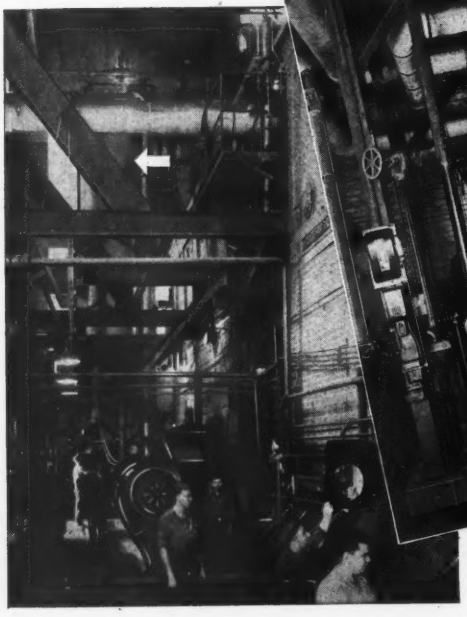
COCHRANE

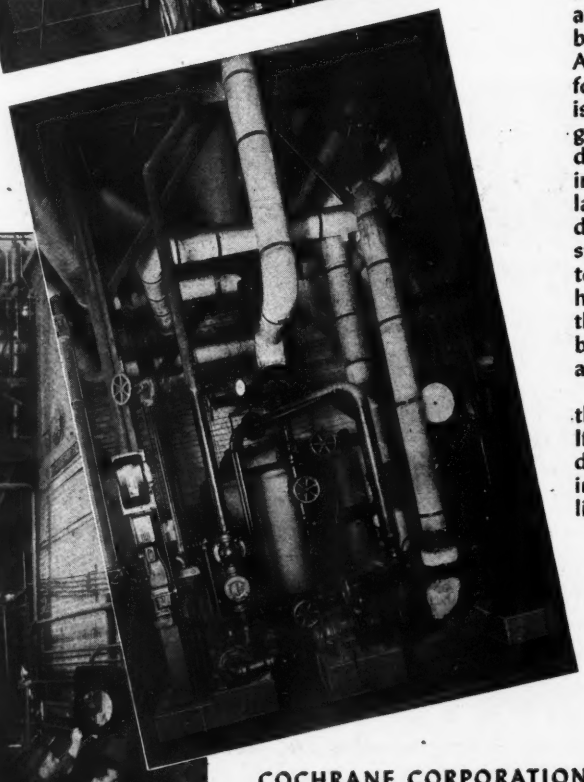
HOT PROCESS SOFTENER

(Above) Showing Sedimentation Tank and Filter in rear, Chemical Proportioning Pump in foreground.

(Lower Right) View of Filter with Sedimentation Tank above.

(Below) Boiler Aisle showing Softener in background.



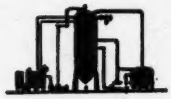


at Cramp's

THE Cramp Shipbuilding Company, or Cramp's Shipyard, as it is known to all Philadelphians, had more to do with the building of America's maritime and naval strength up to the middle thirties than probably any other yard in the country. Then with little marine activity it was shut down for 13 years, but at the start of World War II it went back into service. The Cramp Shipbuilding Company since then has turned in a fine record of performance, and is still going strong.

In the boiler room, the 30-year old boilers, put back into service after their 13-year lay-off, are being operated at 250% of rating. Among the factors given credit for their excellent performance is a Cochrane 12,000 gph (5,000 gph raw water, 7,000 gph condensate) Hot Process Softener installed in 1941. Since its installation, though the boilers have delivered 1,500,000,000 lbs. of steam, it has not been necessary to turbine the boiler tubes, there have been no tube failures and the only attention necessary has been to wash the boilers out with a hose once a year.

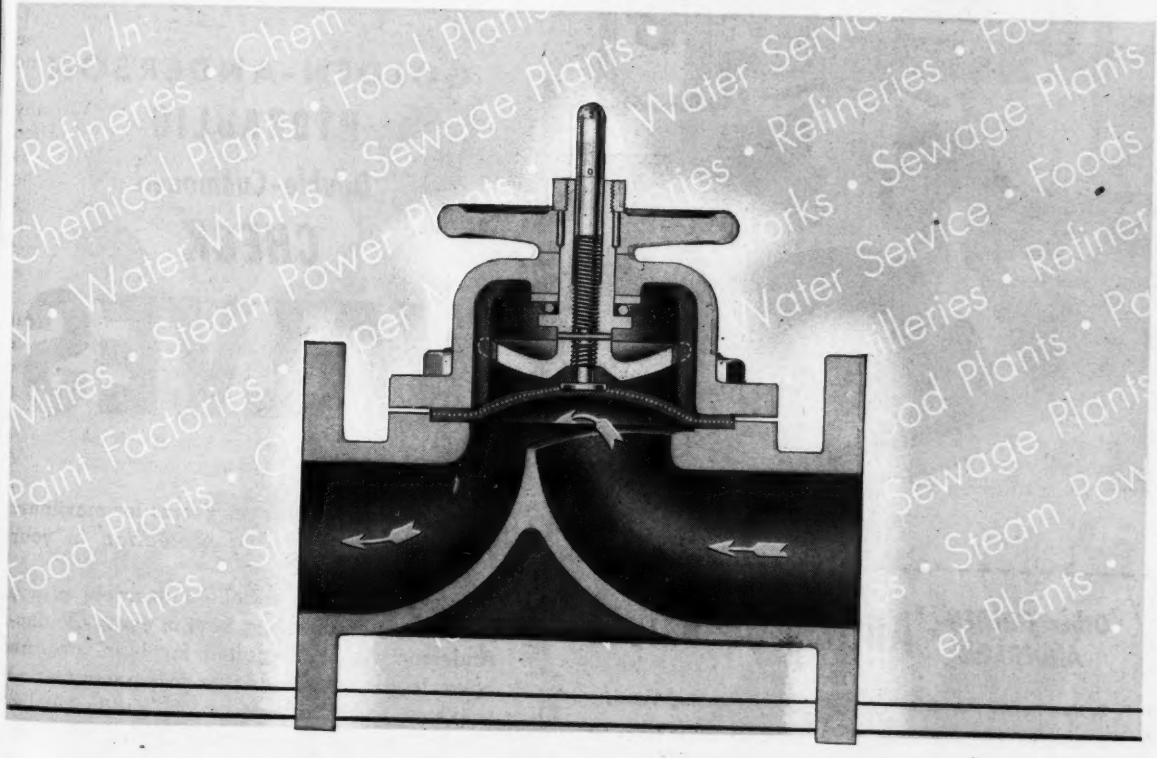
Such performance is typical of the Cochrane Hot Process Softener. If you are interested in water conditioning of boiler feed or other industrial water supply, write for literature or other data.



COCHRANE CORPORATION • 3123 North 17th Street PHILADELPHIA 32, PA.

NOW...A VALVE THAT LAUGHS AT CORROSIVES AND ABRASIVES

...and cannot LEAK, "FREEZE" or JAM!



McAlear No. M-1455 Diaphragm Valve

★ *Pressures, Vacuum to 150 lbs.* ★ *Temperatures to 150° F.* ★ *Sizes ½" to 6".*

- Applicable for air and water lines and special services.
- Used in *every* industry that handles corrosive or abrasive fluids.
- Diaphragm separates mechanism *completely* from fluids handled.
- Shut-off positive—even with solids trapped on seat.
- Closure not dependent on metal-to-metal contact.
- Cannot leak in any position.
- Requires no re-packing.
- Requires no re-seating.
- Diaphragm replaceable with valve in line.
- Special pressure operated types for automatic or pilot control.

FOR BULLETIN giving complete data, write McAlear Manufacturing Company, Automatic Control Division of Climax Industries, 1915 S. Western Ave., Chicago 8, Illinois.

CLIMAX INDUSTRIES

McALEAR

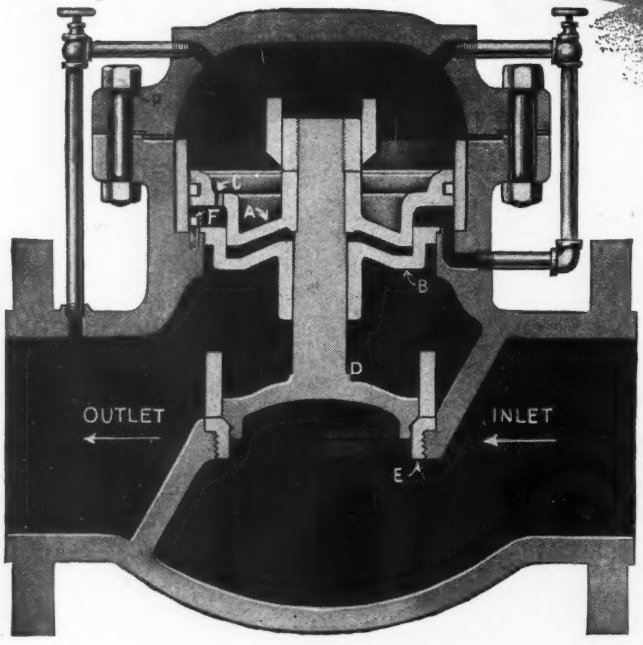
PRESSURE · FLOW · LIQUID LEVEL TEMPERATURE

controls

for STEAM, WATER, AIR, OIL-GAS

Engineered PROTECTION

FOR HIGH PRESSURE BOILER FEED LINES



GOLDEN-ANDERSON HYDRAULIC *Double-Cushioned* *CHECK* VALVES

Look to Golden-Anderson Valves for maximum *engineered safety and protection* in your boiler room.

This valve is an excellent example of the outstanding engineering built in every Golden-Anderson Valve. Designed for high pressure boiler feed lines, the double cushioning feature prevents any shock or jar in sudden valve closure. Needle valve control allows close adjustment to regulate the operating speed for *any* operating condition. Also available with manual handwheel control, in angle or globe patterns, sizes 2½" to 14"

Other GOLDEN-ANDERSON Automatic Valves

- Non-Return Valves
- Throttle and Automatic Engine Stop Valves
- Emergency Trip Valves
- Pressure Reducing Valves
- Altitude Control Valves
- Float Operated Control Valves
- Coke Quenching Valves
- and many other types for safe, dependable flow control.

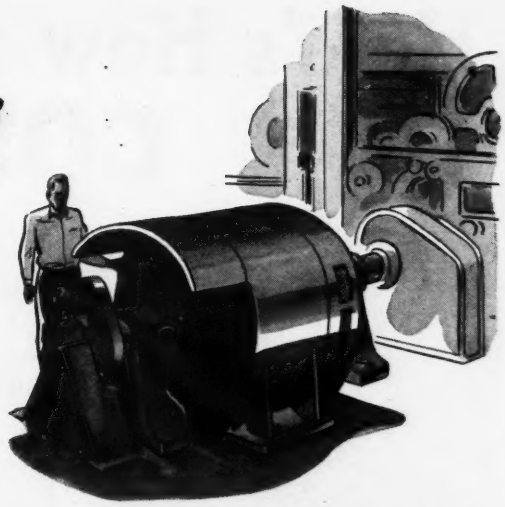
GA

Write for descriptive technical catalog!

GOLDEN-ANDERSON VALVE Specialty Company

FULTON BUILDING • PITTSBURGH 22, PA.

"What! Stop a 30" Calender Roll in Less than 14" of Roll Travel!"



"Right! And besides that emergency stop, give us 10 to 1 speed range on the motor and hold speed *close*. The torque characteristic of our calender requires that the motor have high overload capacity at low speeds without overheating. And because of operating conditions, we want sparkless commutation too!"

B-b-u-t-t... "No buts" said Mr. Rubber Mill Man, "that's *exactly* what we need. You see, we're experimenting with new materials on our rolls, and since we can't *pre*-determine best roll speeds for them, we must have a drive that'll give us complete *range* of speeds, and at the same time, complete *protection* for our workers".

"In A Nutshell, you and the control engineers must design a calender drive system that'll give us *higher* and *lower* calender speeds, *closer* speed regulation and *sudden* emergency stopping — *all three!*" Well, we set up meetings between the control and motor designers to plan a *coordinated* design that would meet the needs.

An Automatic Speed Control incorporating both our m-g set and "Regulex" exciter was designed to hold selected speed within close limits. And, after a careful analysis of required load characteristics, we designed a 400 hp d-c motor of low inertia for quick stopping . . . and which also provided speed range from 25 to 250 rpm.

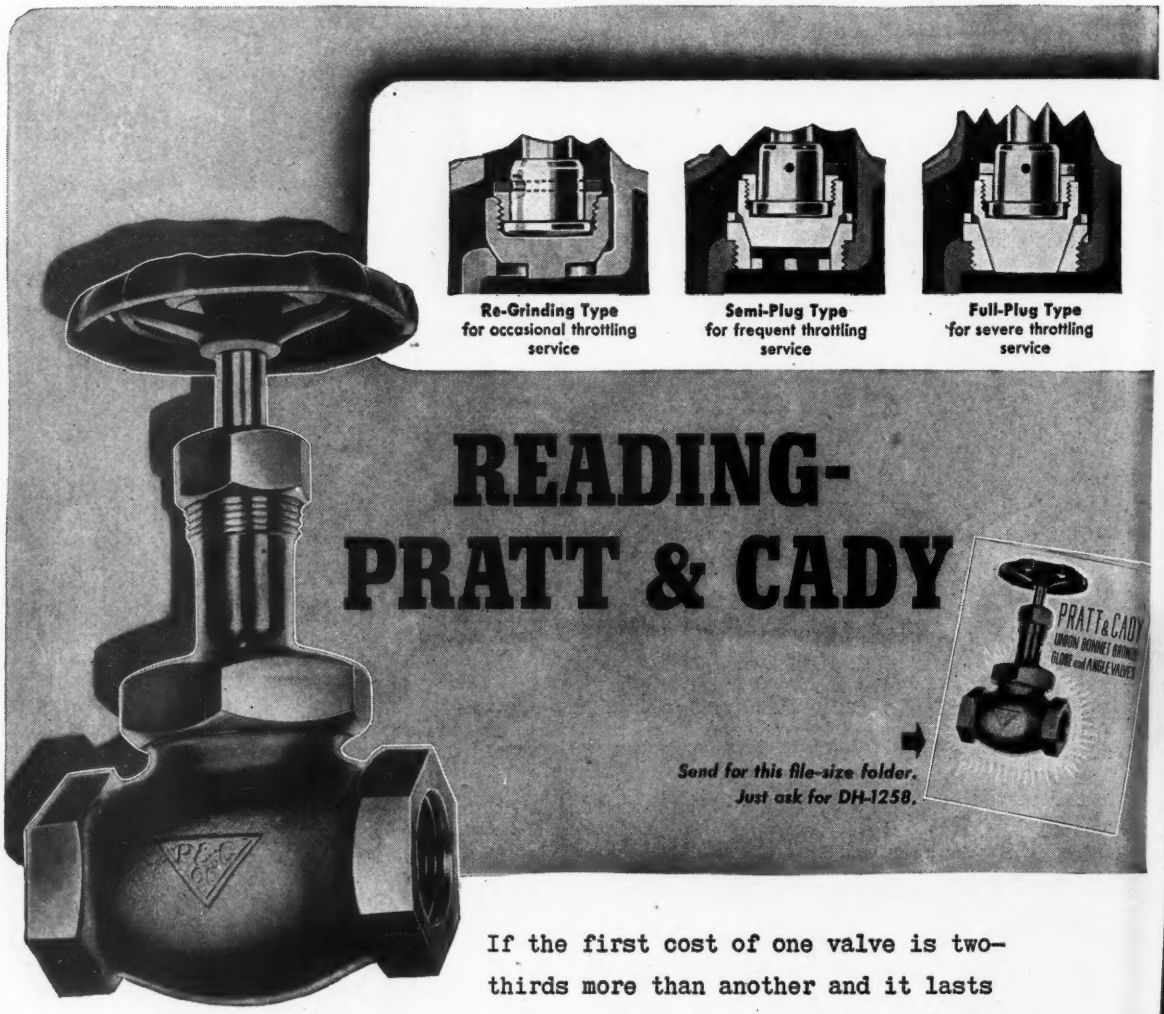
Remember That 14" Stop? After the system went in, we stopped the rolls first at 18" . . . easy. Then at 14" . . . at 12" . . . at 9"! And we probably would have stopped 'em even shorter but for possible danger of too sudden stops to the calender gear system. And commutation? After 6 months, the operators say it's perfect. A 2048

Moral: Every time Allis-Chalmers discovers new ways of solving *special* motor problems, like this one, it also learns how to build better *standard* motors for you! Watch for these new and better motors from A-C. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

Here's How a Better Valve COSTS LESS



If the first cost of one valve is two-thirds more than another and it lasts eight times as long in the same service – it's a more economical valve to buy. In the long run, it actually costs less.

That is the basis on which Reading-Pratt & Cady offers this superior line of union bonnet bronze globe and angle valves. Reading-Pratt & Cady distributors are located in principal cities.

Reading Cast Steel Valves and Fittings • Pratt & Cady Brass and Iron Valves
d'Este Automatic Regulating Valves

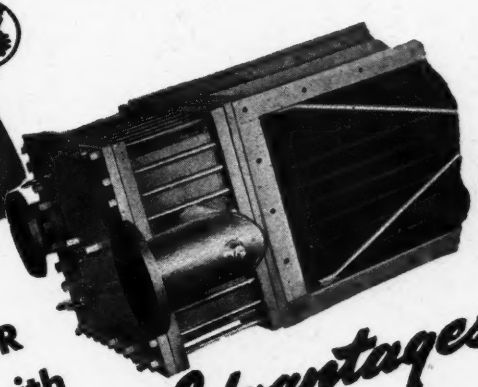
ACCO

Reading, Pa. • Atlanta • Chicago • Denver • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • Portland, Ore. • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

K-FIN



the GENERATOR AIR COOLER with 9 Important Advantages

1. **LASTING TIGHTNESS** . . . assured by patented Multigroove roller expanded packless tube joints at both ends
2. **LOW INSTALLATION COST** . . . permitted by compact design, requiring only simple piping and duct work
3. **FREE EXPANSION AND CONTRACTION** . . . permitted by the flexible tubing insert between shell frame and floating tube sheet
4. **MAXIMUM HEAT-ABSORBING SURFACE** . . . provided by the patented helical K-Fin heat transfer surface which greatly increases the exterior area of the tubes
5. **CONVENIENT ACCESS** . . . permitted by readily removable cover plates at each end for inspection and cleaning.
6. **CONVENIENT TUBE REPLACEMENT** . . . individual tubes can be withdrawn without disturbing adjacent tubes
7. **RIGID CONSTRUCTION** . . . support plates hold tubes in correct position throughout their entire length, and design eliminates tube vibration
8. **LOW AIR PRESSURE LOSSES** . . . provided by generous tube spacing
9. **EFFICIENT WATER DISTRIBUTION** . . . assured by simple multi-pass water heads which also provide efficient use of allowable water pressure drop

Write for Bulletin 1219 describing these units in detail.

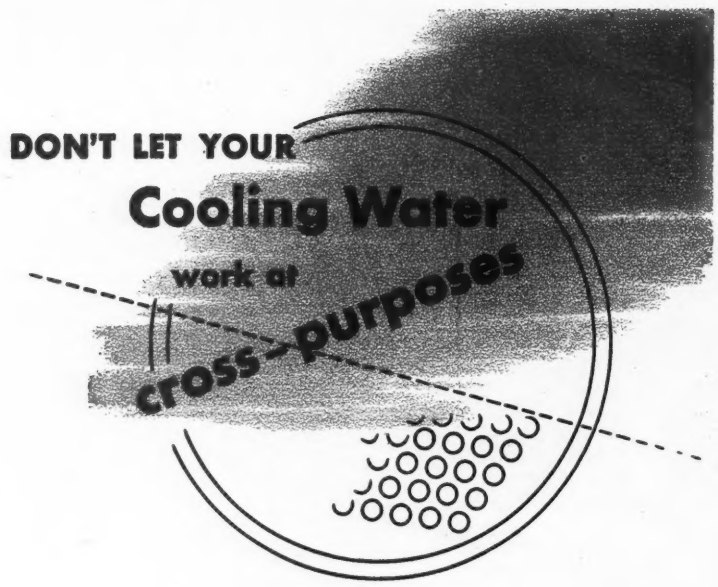
ONE OF A SERIES OF ADVERTISEMENTS DESCRIBING THE MANY TYPES OF G-R HEAT TRANSFER APPARATUS

G-R BUILDS ALL THESE UNITS FOR HEAT TRANSFER SERVICE . . .

Evaporators
Stage Heaters
Gas Coolers
Drain Coolers
Aftercoolers
Air Preheaters
Fuel Oil Heaters
Jacket Water Coolers
Process Heat Exchangers
Transformer Oil Coolers
Generator Air Coolers
Lubricating Oil Coolers
Storage Tank Oil Heaters

THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus



● Cooling water nearly always contains micro-organisms that threaten to defeat its cooling power. These organisms are the "slime-formers" that multiply at warm temperatures and form mucilaginous films on the water-side surfaces of condensers.

Particles of inorganic matter become imbedded in the slime, producing a tough, insulating coating that greatly retards heat transfer, often to such an extent that condensers cannot function at rated capacity

To clean out such deposits by any mechanical means requires expensive shutdowns *periodically*, for the slime immediately begins to accumulate again after every cleaning. Chlorination, however, destroys slime growths already present, and prevents recurrence by killing the slime-forming organisms in the water supply, so that water-side surfaces of condensers remain clean month in and month out.

Every cooling water system requires individual treatment to assure satisfactory slime control at minimum expense. W&T engineers will gladly make a survey and recommend the method of chlorine application best adapted to the particular needs of your plant.

WALLACE & TIERNAN PRODUCTS, INC.

Manufacturers of Chlorine and Ammonia Control Apparatus

Belleville 9, N. J. • Represented in Principal Cities

CD-215

(Continued from page 128)

Coal Controls Lifted

LIFTING OF certain Government controls over the distribution of bituminous coal to take effect April 1 was announced recently by Acting Solid Fuels Administrator Oscar L. Chapman. Regulations controlling coal for export are not affected and remain in force.

The order revokes all provisions of the bituminous coal regulation (SFAW Regulation No. 27, as amended) except for certain reports on distribution, which will still be required by the Administration.

Regulation of the distribution of soft coal was modified on December 1, after the close of the navigation season on the Great Lakes. Now all preferences in its distribution are revoked, effective April 1. The same holds true of limitations on stockpiling of bituminous coal, and the responsibility for an equitable distribution reverts to the individual members of the industry itself.

Penn Electric Gets New Assets

THE PENNSYLVANIA ELECTRIC CO., Johnstown, Pa., has filed with the Federal Power Commission an application for authorization to acquire all the utility assets and facilities and assume certain liabilities of the Pennsylvania Edison Co., Altoona, Pa., for a cash consideration of $42,451,400.

The financing of the acquisition will be through issuance and sale by Pennsylvania Electric of $23,500,000 First Mortgage Bonds, 101,000 shares of Cumulative Preferred Stock, $5,000,000 of ten year Serial Notes, 68,843 shares of $20 par value Common Stock, and the remainder from cash on hand.

Steel in War

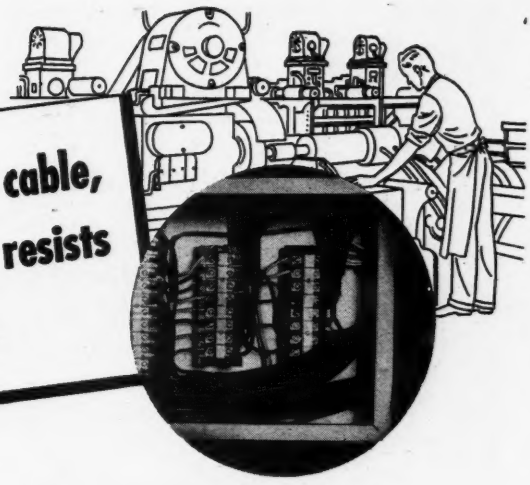
THE WAR ROLE of a basic American industry and its largest producer is fully revealed for the first time in a new book, "Steel in the War," a now-it-can-be-told story of an industrial accomplishment which contributed so much to the victory of the United Nations in World War II. It is the war story of United States Steel Corp.

"Steel in the War," published by United States Steel, assembles for the first time facts and figures which measure the importance to the national security of this basic metal. It leaves the reader with an impression of industrial energy that, often taken for granted, is nonetheless a prime factor in our national development. The book, which is generously illustrated, has been made available to thousands of libraries where it may be used as an industrial reference volume.

Coatsworth to E.E.I.

JAMES T. COATSWORTH, former sales promotion manager, Public Service Co. of Colorado, assumed the position of commercial director of Edison Electric Institute, on April 1st.

Mr. Coatsworth succeeds C. Ernest Greenwood, who has been commercial director of the Institute and its predecessor for 18 years, and has reached the retirement age. Mr. Greenwood's future plans will be announced later.



PROBLEM: to find insulated cable, for wiring machine tools, which resists all kinds of cutting fluids

First solved with FLAMENOL *cable*

● Not long after the introduction of Flamenol*, in 1935, a prominent manufacturer of automobiles was searching for insulated cable which would withstand machine-tool cutting oils and coolants. When a G-E sales engineer showed the manufacturer a sample of Flamenol—and described its excellent resistance to oils, water, and heat—the company's chief electrician immediately ordered 6000 feet. The company found this cable so satisfactory that it now specifies Flamenol to be installed on all the machine tools it buys. If you have a problem of finding insulated cable or wire that will withstand severe conditions, such as contact with cutting fluid, Flamenol may very likely be the answer. It has proved its many desirable properties in hundreds of power and lighting applications.

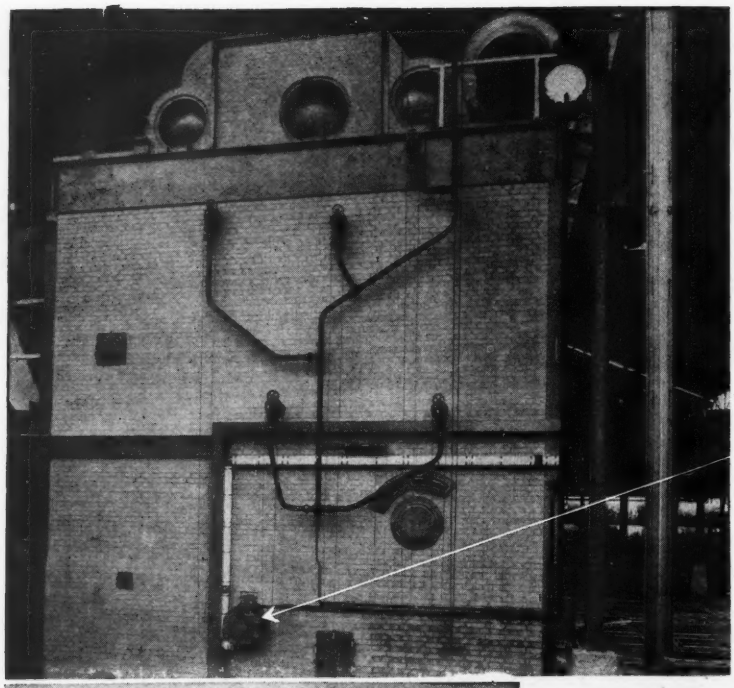
RESISTS FLAME—Flamenol does not support combustion. Thus, it prevents serious outages due to fires that involve wiring. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Flamenol's insulation strips easily and leaves the conductor surface untarnished. It is highly resistant to oils, water, mild acids and alkalis, and weather. It is tough, stable, and flexible at low temperatures, and has high dielectric strength.

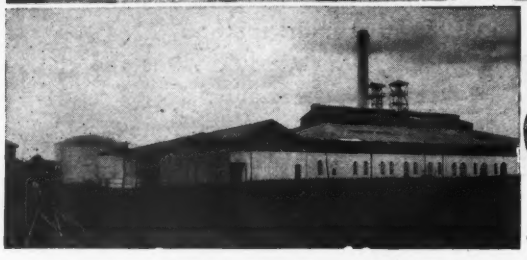
A G-E "FIRST"—Only G.E. makes Flamenol wire and cable. Flamenol is the pioneer of wire and cable insulated with plasticized polyvinyl chloride. It was produced by G.E. in 1935—not as a substitute for rubber-insulated wire, but as a new type possessing desirable properties not available with rubber. To find out how Flamenol can help solve your problems—save you time, trouble, and expense—ask our local office, or write General Electric Company, Schenectady 5, N. Y.

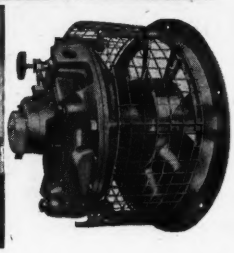
*Trade-mark reg. U.S. Pat. Off.

GENERAL ELECTRIC

502-52-1200







Wing Turbine Blowers at Central Mercedita

There are eight Wing Turbine Driven Forced Draft Blowers at the big sugar mill "Central Mercedita." They supply forced draft for the Ward Single Pass Bagasse Furnaces which fire the Babcock & Wilcox Stirling Boilers of 3700 H.P.

Wing Turbine Blowers, as used in this plant, are used in many a sugar central's boiler plant. They are simple and rugged in construction, quiet and dependable in operation. Their compact design has made them the favorite with boiler manufacturers and operators all over the world.

Write for a copy of Bulletin T-98

Wing L. J. Wing Mfg. Co.,
64 Seventh Avenue New York 11, N. Y.
Factories: Newark, N. J., and Montreal, Canada

Refrigeration Meet

STEPS TO assure an uninterrupted flow of parts and equipment, even when the industry attains its full capacity, were completed at a series of meetings and conferences of 100 manufacturers and twice that many wholesalers in the mechanical refrigeration and air conditioning industry.

An expanded co-operative program to utilize the industry's maximum productive capacity, now two to three times greater than in prewar years, was adopted at the Spring conference of the Refrigeration Equipment Manufacturers Association and the Refrigeration Equipment Wholesalers Association held in Chicago March 4-7.

During the four-day meeting, the two associations held separate sessions to transact the individual business of each group. Common problems of the two branches of the industry were discussed at a joint session of REMA and REWA on Wednesday, March 6. Booths in the exhibition hall of the Stevens Hotel, the meeting headquarters, were used by manufacturers for conferences with the wholesalers during the four-day conclave.

Slepian Gets French Award

A FRENCH GOVERNMENT decoration he was awarded in pre-war Paris in 1939 has been conferred almost seven years later in Pittsburgh on a self-made electrical engineer, naming him officially an "Officier d'Academie."

One of the six such awards made to Americans by the French Ministry of National Education, the certificate was sent through the American Embassy in Paris, via the State Department, to Dr. Joseph Slepian, associate director of the Westinghouse Research Laboratories. The award followed a visit by Dr. Slepian to France in 1938, during which he lectured on scientific subjects and conferred with noted French scientists.

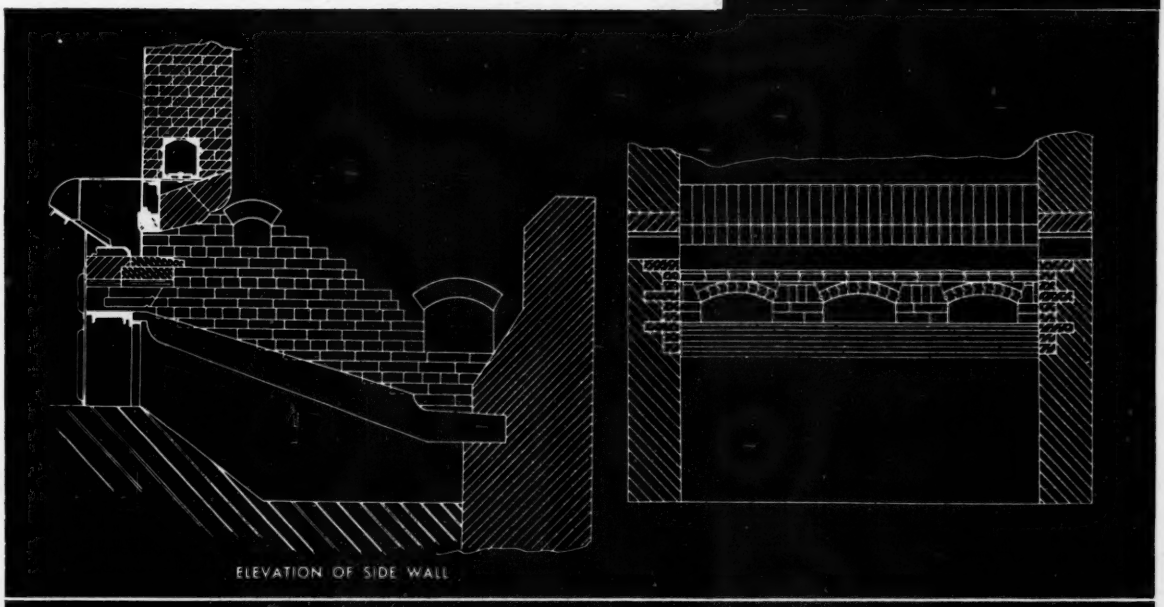
Psychrometric Committee

AT ITS NEXT meeting the International Joint Committee on Psychrometric Data will concern itself with the thermodynamic properties of moist air in accordance with an agenda prepared by a sub-committee consisting of John A. Goff, Dean, Towne Scientific School, University of Pennsylvania; Dr. C. S. Cragoe, Chief, Heat Measurements Section, National Bureau of Standards; S. Gratch, Instructor in Mechanical Engineering, Towne Scientific School, University of Pennsylvania; Dr. L. P. Harrison, Chief, Technical Investigations Section, U. S. Weather Bureau; and Dr. F. G. Keyes, Professor Chemistry, Massachusetts Institute of Technology.

J. H. Walker, vice president, Detroit Edison Co., is chairman, and states that the primary objective of the committee is to establish standard tables on the properties of air and water vapor mixtures, for adoption as an international standard thus, eliminating the discrepancies in the values which exist in the several tables now in use.

WALL BRICK DATA

PERFECTION heavy duty STOKER



ELEVATION OF SIDE WALL

Because it costs less to get more steam

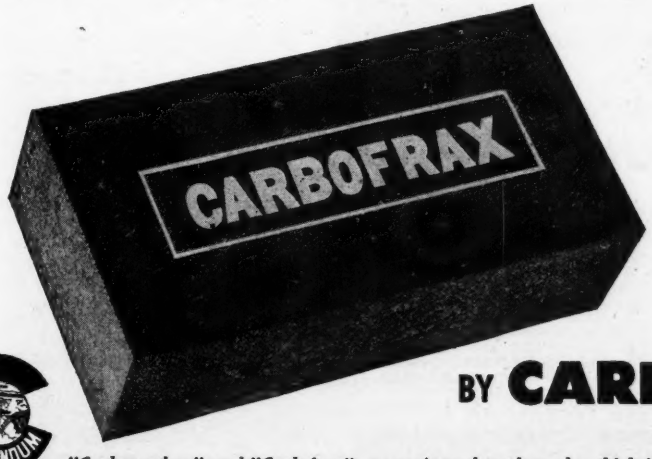
More and cheaper steam is assured by the CARBOFRAX silicon carbide brick setting designed for use with the Perfection heavy duty stoker shown here. Of course, the actual height of the lining may vary with operating conditions . . . but there is no question of increased efficiency and economy.

Here is why.

Clogging, heat consuming and space taking clinkers do not cling to the hard surface of CARBOFRAX brick. Even at extremely high temperatures, these brick do not provide an anchorage because they do not soften. The entire grate area remains free for more efficient combustion. A cleaner, more active fire means savings in fuel cost.

Steam production is further increased by continuous extended life from the CARBOFRAX brickwork. Reports of 8 to 10 years—even longer—on-the-line service are on record. In comparison with ordinary refractory installations, outages for repairs are hardly worth mentioning. The resultant drop in both labor and material costs alone is worth looking into.

As a matter of fact, you will find it well worthwhile to make a complete investigation of all the advantages of CARBOFRAX settings. It's easy to get complete information on how their elevated refractoriness, great mechanical strength at high temperatures and outstanding resistance to both mechanical and flame abrasion can improve your operation. Simply ask for your copy of an illustrated technical booklet "CARBOFRAX in Boiler Furnaces." Send in your request to Dept. H-66, The Carborundum Company, Refractories Division, Perth Amboy, N. J.



BY **CARBORUNDUM**

TRADE MARK

"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company

FULLY AUTOMATIC
ROD PACKING SHOWS UP TO
300% LONGER LIFE

CHESTERTON Parachute Packing

- This revolutionary new packing requires no gland pressure.
- It is also fully automatic and self-sealing.
- Has nested rings with protruding edges which expand and seal under pressure.
- Widely used for hydraulic rams, plungers, accumulators, vulcanizers.
- Shows up to 300% longer working life, say many engineers.
- Made in exact sizes for any installation. To order state sizes of rod, stuffing box, depth, pressure and type of liquid.

WRITE FOR Free 72-PAGE PACKING HANDBOOK

A. W. CHESTERTON CO.
64 INDIA STREET • BOSTON, MASS.
DISTRIBUTORS IN PRINCIPAL CITIES

"Boiler Repairs Reduced 75%"
writes user of NATIONAL GIRTH SEAM PROTECTOR

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

Philips Review Resumes Publication

PHILIPS TECHNICAL REVEIW, which was published monthly before the war in four languages by the Research Laboratory of N. V. Philips Gloeilampenfabrieken of Eindhoven, Holland, has resumed publication.

It was explained that publication of international editions of the Review was forbidden by the Nazis at the beginning of 1942, although the Dutch edition was permitted to continue until July. The seventh volume, 1942, therefore consisted of only six numbers. It is planned to make these available in the English edition.

Subscriptions for the Review are being handled exclusively in this country by Elsevier Publishing Co., 215 Fourth Avenue, New York. Yearly subscription price for 12 monthly issues is $5.00 including postage.

ASTM Building

SHORTLY AFTER May 1, the American Society for Testing Materials which for a number of years has had its headquarters at 260 S. Broad St., Philadelphia 2, Pa., occupied its permanent headquarters building at 1916 Race St., Philadelphia 3, Pa. This building, which was purchased and remodeled through contributions made by many of the companies and individuals active in the Society's work, will provide much needed additional space.

New Chief of Coal Division

DR. LOUIS C. MCCABE, an authority on the mining, preparation and properties of coal, joined the Bureau of Mines staff on April 5 as chief of the Coal Division in the Fuels and Explosives Branch, it was announced recently.

In his new position, with headquarters in Washington, D. C., Dr. McCabe will supervise the Bureau's research on the mining, preparation, carbonization, and gasification of coal and kindred subjects at the Bureau's experiment stations and pilot plants in various parts of the country. He comes to the Bureau from the American Gas and Electric Co. of New York City, where he has been employed since he was released from the Army.

Patent Council Governors Named

ELECTION of seven smaller manufacturers to serve as Governors of National Patent Council and to lead a nationwide educational program in defense of the patent system was announced just recently by John W. Anderson, manufacturer of automotive equipment and president of the Council. Elected were: Henry K. Norton, treasurer, Walter Kidde & Co.; Melvin M. Johnson, Jr., president, Johnson Automatics, Inc.; E. A. Terrell, president, Terrell Machine Co.; Phil T. Sprague, president, The Hays Corporation; W. L. McKnight, president, Minnesota Mining and Manufacturing Co.; C. B. Hasford, president, L. P. G. Equipment Corp.; and Jay C. Pemrrin, pres., Towlsaver, Inc.

You Can See for Yourself . . .

WHY the Foster 38-SV Safety Valve is ESPECIALLY SUITABLE FOR

HIGH PRESSURES HIGH TEMPERATURES

Pressures up to 3000 pounds and temperatures of 1000° F. are easily handled by the Foster Type 38-SV Super-Jet Safety Valve—it was designed especially for just these exacting requirements! It's no mere "beefed-up" low-pressure valve—rather it's a basic new design for high-pressure service.

Only the Foster 38-SV Safety Valve gives you all these advantages:

1 . . . ***Exceptional steam economy*** because . . . it reseats as low as 1% below popping pressure . . . reseating is positive; without pounding or chatter . . . blowdown is adjustable from 8% down to 1%.

2 . . . ***Unaffected by temperature changes*** because . . . frame rod construction makes crawl negligible . . . deflector protects spring and rods from escaping steam.

3 . . . ***Maximum protection*** because . . . full opening is practically instantaneous . . . full rated nozzle capacity is available at popping pressure . . . once set under operating conditions, its popping point is constant.

4 . . . ***Positive reseating*** because . . . floating disc design . . . steam-centered piston . . . permanently flat seats.

Specify the Foster 38-SV Super-Jet Safety Valve for the finest in high-pressure protection!

Complete details of the Foster 38-SV Super-Jet Safety Valve, for pressures up to 3000 pounds and temperatures up to 1000° F., are given in Bulletin 25. Write for it today!

FOSTER ENGINEERING Company

PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . DAMPER REGULATORS . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . LIQUID LEVEL CONTROLLERS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN AND TRIPLE DUTY VALVES . . . VACUUM REGULATORS OR BREAKERS . . . SIGHT FLOW BOXES . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

111 MONROE STREET • NEWARK 1, N. J.

ACCURACY ASSURED!

✓ Built-in Accuracy
Rugged construction without close clearances.

✓ Easy to Check
Easily tested right on the job without costly apparatus.

HENSZEY
Feed Water
METER

"Double Check" accuracy is why Henszey Meters are used for dependable measurement of boiler feed water, boiler blowdown, condensate, chemicals and other similar liquids. If you have a hard-to-measure problem that requires unfailing accuracy — write today for a practical answer from Henszey . . . representatives in leading cities.

HENSZEY COMPANY · Dept. C6, Watertown, Wis.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Boiler Feed Regulators • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

Army's Technical Personnel Needs

CALLING for continued War Department leadership in scientific research and development, Robert P. Patterson, Secretary of War, emphatically stated recently the War Department's policy of "pursuing a vigorous and comprehensive technological program to assure security beyond any question of doubt."

In a memorandum for the Chief of Staff and the Commanding Generals of the Air, Ground and Service Forces, Secretary Patterson declared, "In the last analysis, the success of the War Department research and development activities depends on the quality and adequacy of its scientific and technical staff."

Twenty-three Sessions at ASTM Meeting

IN ADDITION to the 23 formal technical sessions which are part of the technical program for the Forty-ninth Annual Meeting of the American Society for Testing Materials in Buffalo, June 24 to 28 inclusive, there will be more than 200 meetings of the Society's technical committees. The seventh exhibit of testing apparatus and related equipment will be in progress, and the annual photographic exhibit also will be held. All sessions will be at the Hotel Statler.

More than 150 technical papers and reports by the country's leading authorities in the field of materials are scheduled, many of them to comprise parts of symposiums. June 24 there is a symposium on bearings, with two sessions each in symposiums on fatigue and on spectroscopic light sources planned for June 25. On June 26 there will be the two sessions of the symposium on testing parts and assemblies, in which the Society for Experimental Stress Analysis is a joint sponsor and on June 25 and 26 there is the two-session symposium on oil procurement practices. The Edgar Marburg Lecture June 26 is to be delivered by Dr. J. J. Mattiello, of the Hilo Varnish Corp., on the subject "Protective Organic Coatings as Engineering Materials."

Other two-session symposiums will cover pH measurements and effect of temperature on the properties of metals. There will be a technical session on the atmospheric resistance of stainless steels, and another on test methods for freezing and thawing concrete.

Several other sessions of the meeting will cover non-ferrous metals, plastics and wood, general testing methods, and cement and concrete.

Fuel Performance Committee

E. J. SCHWANHAUSSER, president of Diesel Engine Manufacturers Ass'n, has announced that the following men in the diesel engine industry will cooperate with a committee from the oil industry in a program aimed to improve fuel performance in diesel engines:

J. W. Linford, American Locomotive Co.; C. B. Hoffman, Atlas Imperial Diesel Engine Co.; G. N.

are you getting the benefits of OTIS MAINTENANCE SERVICE?

In the past ten years the number of Otis elevators under Otis Maintenance more than doubled. It also more than doubled in the previous ten years.

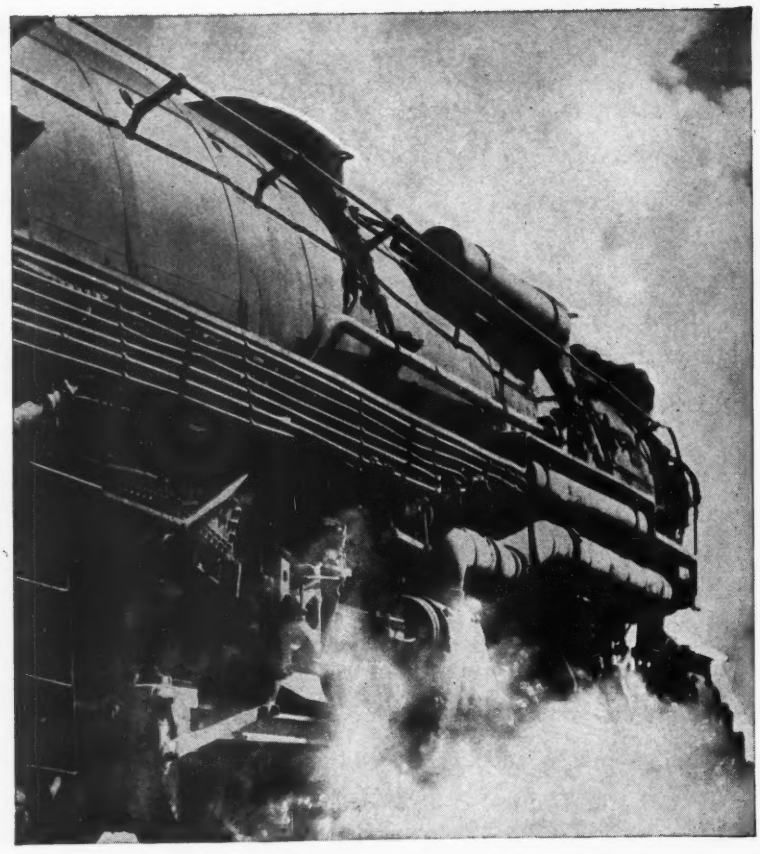
Under Otis Maintenance building owners and managers are freed from all details of elevator care and repair. At the same time tenant satisfaction is increased, more freight is moved and time saved. Those are the reasons why owners and managers know that Otis Maintenance pays.

Not only long Otis life, but peak Otis efficiency. This Otis maintenance man is checking the speed of an elevator to be sure it is delivering good service.

Otis Maintenance is a home town service because it operates through 245 branch offices, each adapted to the area it serves. It is an integrated national enterprise because it brings the research, engineering and production facilities of the manufacturer directly to your door.

Otis Maintenance is for Otis elevators. It is available at a flat monthly rate through your local Otis office.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES



YOU CAN'T GET POWER FROM LOST STEAM!

Steam—or any gas or liquid—leaking past a faulty gland or stuffing box . . . is lost for processing or as a source of power. The *wasted time* and *lost production* resulting from frequent replacement of improper or poor quality packing is a loss of much greater importance! That's why the use of "any packing that's handy" should be guarded against.

USE THE *RIGHT* PACKING!

PALMETTO makes the *right* packing for every one of your applications . . . the right quality for most economical maintenance . . . the right design for most effective sealing—with least wear to rods, shafts and stems.

Write today for bulletins which show what packings to use where.

GREENE, TWEED & CO.
Bronx Blvd. at 238th St., New York 66, N. Y.
Plants at New York, N. Y. and North Wales, Pa. GT-1536

PALMETTO PALMETTO for steam, water, air. PELRO for oils. CUTNO for alkalis. SUPER-CUTNO (blue asbestos) for acids. KLERO for foods.

Self-Lubricating **PACKINGS**

Guerasimoff, The Buda Co.; Ralph Jackson, Busch - Sulzer Bros. - Diesel Engine Co.; P. L. Callan, Chicago Pneumatic Tool Co.; Ralph Boyer, The Cooper-Bessemer Corp.; H. L. Knudsen, Cummins Engine Co., and T. M. Robie and L. D. Thompson, Fairbanks, Morse & Co.

R. C. MacKinnon, Fulton Iron Works Co.; Paul Shirley, General Machinery Corp.; H. M. Gadebusch, Detroit Diesel Engine Division, General Motors Corp.; O. D. Treiber, Hercules Motors Corp.; H. F. Bryan, International Harvester Co. and Walter F. Lathrop, The Lathrop Engine Co.

Earl McMahon, Lister-Blackstone, Inc.; William M. Walworth, Mack Trucks, Inc.; Robert Cramer, Nordberg Manufacturing Co.; Frank Peacock, Sterling Engine Co.; J. H. G. McConechy, Sun Shipbuilding and Dry Dock Co. and J. C. Barnaby, Worthington Pump and Machinery Corp.

The program of research will be conducted by the Automotive Diesel Fuels Division of the Coordinating Fuels Research Committee, which is a part of the Coordinating Research Council. The Council is sustained by the American Petroleum Institute and the Society of Automotive Engineers.

Personnel of the Automotive Diesel Fuels Division is as follows:

Dr. D. P. Barnard, Standard Oil Co. (Ind.), chairman; Harold M. Smith, Bureau of Mines; Capt. W. C. Latrobe, U. S. Navy; C. B. Veal, Coordinating Research Council; C. D. Lowry, Jr. and J. S. Bogen, Universal Oil Products Co.; Walter G. Ainsley, Sinclair Refining Co.; John C. Day, Western Petroleum Refiners Association; Comm. Norman H. Hall, U. S. Coast Guard, and Mr. Robie and Mr. Thompson.

Wrench Practice

THE PROPOSED simplified practice recommendation for open-end and box wrenches has been approved for promulgation, according to an announcement of the Division of Simplified Practice of the National Bureau of Standards. It is effective from April 15, 1946, and will be identified as R220-46, Open-End and Box Wrenches.

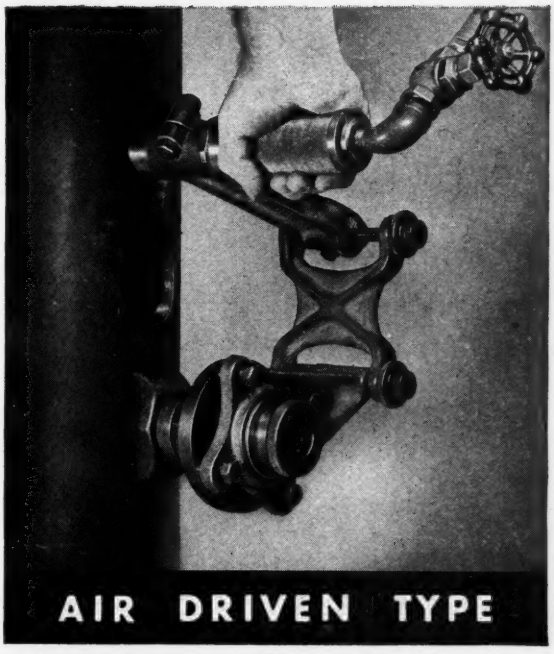
Eshbach Receives Chanute Medal

DR. OVID W. ESHBACH, Dean, Northwestern Technological Institute, has been chosen to receive the Octave Chanute Medal for year of 1945 from the Western Society of Engineers, Dr. Henry T. Heald, President of the Society has announced. Formal presentation of the medal will be made at a later date.

The Chanute Medal is awarded each year for best papers on various engineering subjects presented before the Western Society of Engineers. Dr. Eshbach's prize winner paper was on post-war engineering education.

Coal Meeting

THE FIRST of a series of meetings to sell coal heating service to the coal industry was held by Appalachian Coals, Inc. at the Netherland Plaza Hotel in Cincinnati, April 18, 1946.



AIR DRIVEN TYPE

MOTOR DRIVEN TYPE

NOW - a fast accurate way to reface HANDHOLE SEATS!

THE NEW ELLIOTT HANDHOLE SEAT GRINDER replaces the old unsatisfactory hand filing and hand-held motor driven grinding methods of refacing handhole seats in boilers, economizers, superheaters or other pressure units. Time saved and precision gained by this new maintenance tool make it a "must" for every boiler room.

Operation of the Elliott Grinder is simple. The unit is easily clamped to a header and the grinding wheel inserted into the handhole. Air or electric power drives the accurately aligned spindle, motion of which is limited to one plane only—and the whole job is completed in a short time. The refaced seat is left smooth and true—to a degree virtually impossible by old hand filing methods.

An added feature of this new Elliott tool is a wire brush, interchangeable with the grinding wheel, which is supplied for cleaning seats which do not require refacing or for pre-refacing cleaning.

PROVEN BY SERVICE

Reports of users in boiler rooms indicate that jobs which formerly took days now are reduced to hours. One man who had taken *an entire day* to reface *one handhole* with a file, completed *fourteen in five hours* with this Elliott Grinder!

Check on your own boiler room refacing methods. Get all the facts about this Elliott Handhole Seat Grinder now and cut outage and manhour losses. Write today.

Y-256

ELLIOTT Company

Lagonda Division, Springfield, O.

Plants at JEANNETTE, PA.—RIDGWAY, PA.
SPRINGFIELD, O.—NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

PATENTED

INCREASED PRODUCTION FOR REFRIGERATION USERS

● You Can Obtain Greater Refrigeration Capacity from your Present Compressor by using NIAGARA DUO-PASS AERO CONDENSER.

This is possible because you use outdoor air as the cooling medium with the extra benefit of evaporative condensing! Condensing temperatures are lowered; condenser capacity is increased; head pressures are reduced—additional compressor capacity is the result.

Only the patented NIAGARA Duo-Pass makes this gain permanent because no other evaporative condenser lowers condensing temperatures to the point where deposits do not accumulate on condenser tubes. This does away with loss of time for cleaning and assures always full capacity.

Write for Bulletins 91 and 93.

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

DEPT. PP-66, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

More than two hundred sales executives and salesmen from all parts of the Appalachian market area attended.

Speakers at the meeting, which was opened by R. E. Howe, president of Appalachian Coals, Inc., were H. A. Glover, vice president of Island Creek Coal Sales Co.; M. L. Patton, president of Cabin Creek Consolidated Coal Sales Co. Both of these men are members of the Marketing Committee of the National Coal Association which is in charge of the operation of Coal Heating Service. Frank G. Reed, director of the American Retail Coal Association; W. C. Perkins, manager of sales of Appalachian Coals, Inc.; Dr. H. J. Rose, vice president and director of research of Bituminous Coal Research, Inc.; Ralph A. Sherman, supervisor of the fuels division of Battelle Memorial Institute; E. D. Benton, fuel engineer of the L. & N. Railroad and H. B. Lammers, director of engineering of the Coal Producers Committee for Smoke Abatement.

Charles R. Griffith, president of the Southern Coal & Coke Co. was chairman of the morning session and Earl C. Payne, consulting engineer of the Consolidation Coal Co., chairman of the afternoon session.

Diesel Course at Penn State

A UNIQUE "refresher" course for 40 instructors of Diesel engineering will get under way at Pennsylvania State College on June 24. The two-weeks session of class room and laboratory work is said to be the first of its kind ever to be held.

The appeal of the idea to professors who teach mechanical engineering in the accredited engineering schools of the country is attested by the fact that more instructors have applied for admission than can be accommodated. They are coming from the states of Washington, California and Oklahoma; from Notre Dame, "M.I.T." and Purdue.

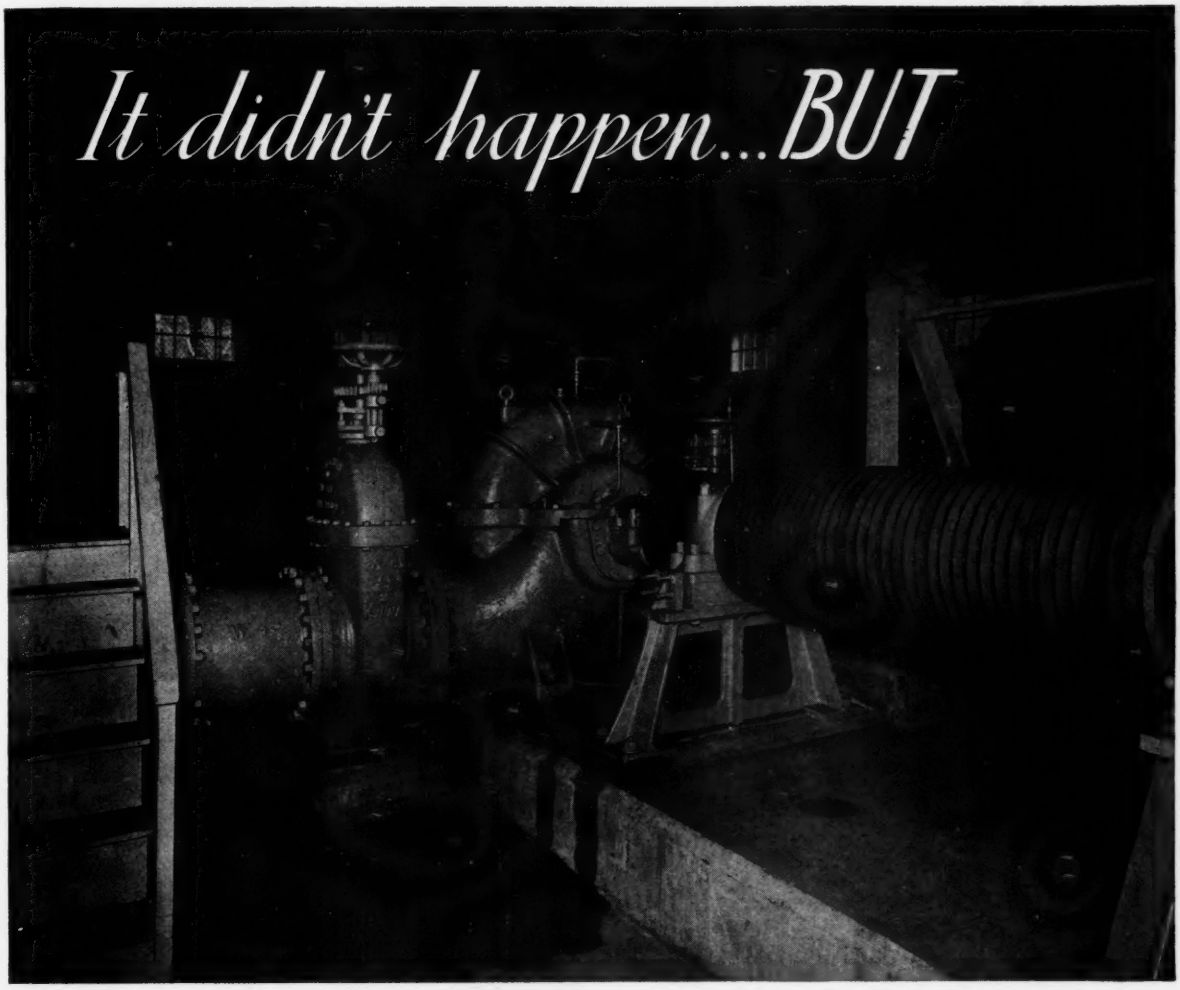
MANUFACTURERS' *News*

Valve Research Coordinated

THE ENGINEERING and Research staffs of the Nordstrom Valve Co. and Edward Valves, Inc. have been pooled to give impetus to their product development program, it was announced recently by Rockwell Mfg. Co. In a recent meeting at the Edward Plant, executives of the sales, engineering and research staffs worked out a long-term program which keeps the advantages of separate operations with extensive exchange of technical design and research data and summaries of investigations.

Within the three plants several hundred projects are now under way. Included are investigations of new metals and lubricants, developments in flow engineering, new manufacturing techniques and adaptability of both companies' valves to new services and processes.

It didn't happen...BUT



DURING the war the Metropolitan District Water Supply Commission of Boston was prepared to meet the emergency which *could* have occurred if its Chestnut Hill Pumping Station had been bombed or sabotaged.

Within an exceptionally short time . . . in a comparitively small space . . . the Commission built an emergency pumping station which had an available capacity of 45 million gallons daily in case of necessity.

To accomplish this, two Warren 18-DL-25 pumps were used, one direct-connected to a 900 HP motor and the other V-belted to a 1250 HP motor (see illustration). These pumps were originally built by Warren for de-watering service in the Quabbin Tunnel project of the Metropolitan District Commission. Thus Yankee ingenuity, plus the versatility of Warren Pumps and Warren engineering, made another worthwhile wartime contribution.

The same product and engineering skill is now available for peacetime projects. Ask for information.

If you have a pumping problem involving:

- ☐ General Water Service
- ☐ Boiler Feed
- ☐ Paper Mill Services
- ☐ Process
- ☐ De-watering
- ☐ Condensate Return
- ☐ Oil Handling
- ☐ Hydraulic Pressures

. . . or other services, your inquiry will receive prompt attention.

P2

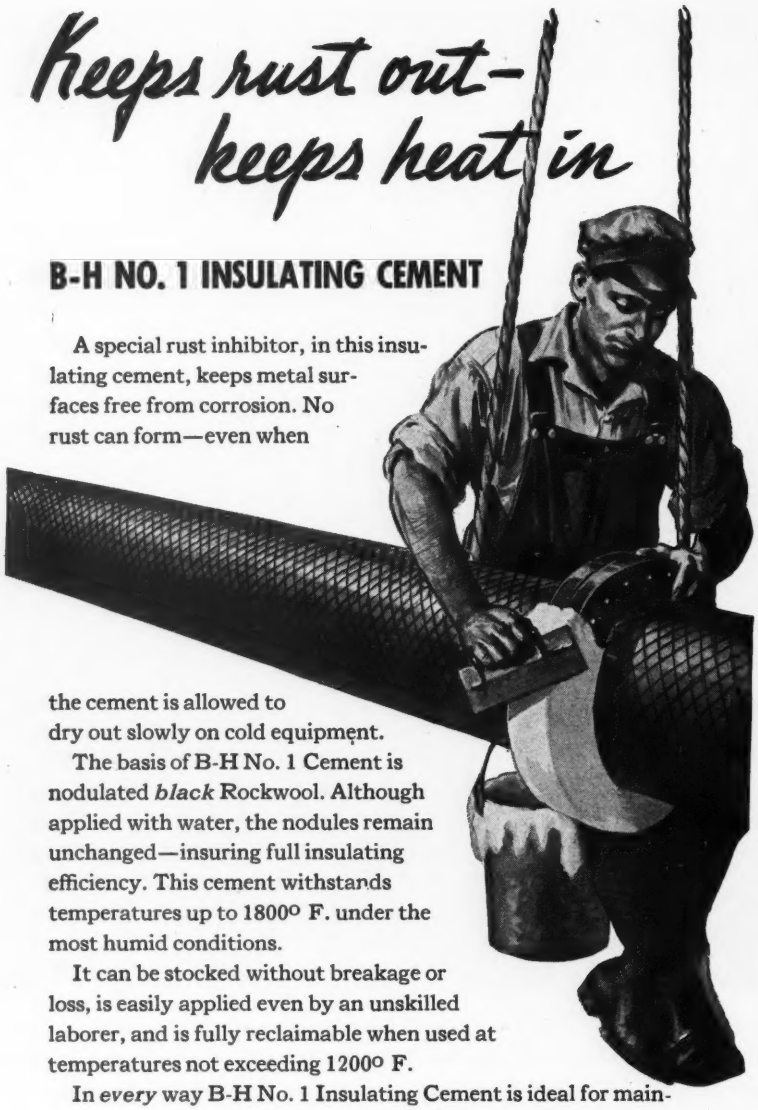
WARREN STEAM PUMP COMPANY, INC. - - - WARREN, MASSACHUSETTS - - - *Able Representatives in Principal Cities*

WARREN PUMPS

Keeps rust out—keeps heat in

B-H NO. 1 INSULATING CEMENT

A special rust inhibitor, in this insulating cement, keeps metal surfaces free from corrosion. No rust can form—even when the cement is allowed to dry out slowly on cold equipment.



The basis of B-H No. 1 Cement is nodulated *black* Rockwool. Although applied with water, the nodules remain unchanged—insuring full insulating efficiency. This cement withstands temperatures up to 1800° F. under the most humid conditions.

It can be stocked without breakage or loss, is easily applied even by an unskilled laborer, and is fully reclaimable when used at temperatures not exceeding 1200° F.

In *every* way B-H No. 1 Insulating Cement is ideal for maintenance work, especially for valves, fittings and irregular surfaces, large or small, and as a finish over blanket and block insulations.

The coupon below will bring you full information and a practical sample of B-H No. 1 Cement.

Baldwin-Hill

SPECIALISTS IN THERMAL INSULATION PRODUCTS

Baldwin-Hill Co., 590 Breunig Ave., Trenton 2, N. J.

Send information on products checked below:

☐ Free sample of B-H No. 1 Cement

☐ No. 100 Pipe Covering—effective up to 1200°F. (for long runs overhead, underground, Diesel exhausts)

☐ Mono-Block—the one-block insulation for all temperatures up to 1700°F.

☐ Black Rockwool Blankets (felted between various types of metal fabrics)

NAME _____ POSITION _____

FIRM _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Sterling Acquires Diesel Rights

THE NATIONAL SUPPLY CO. of Pittsburgh and the Sterling Engine Co. of Buffalo have announced that the latter company has purchased the manufacturing and servicing rights to the high-speed diesel engines formerly produced at National's Superior Engine Division, Springfield, Ohio. Production of the engines will be taken over by Sterling as soon as tools and inventory can be transferred from Springfield to Buffalo.

Lockwood Greene Elects Allen

LOCKWOOD GREENE ENGINEERS, INC., has announced the election of Chester S. Allen as president to succeed the late Albert L. Scott, who died recently.

Mr. Allen's professional experience dates from 1904 when he was a draftsman, estimator and structural engineer for Norcross Brothers of Worcester, Mass. Since that time he has been associated with United Fruit Co., Sanford E. Thompson, Hahneman Hospital in Buffalo, and since 1910, with Lockwood Greene. Mr. Allen is active in civic affairs and is member of several engineering societies.

Kellogg Elects; Reveals Plans

M. W. KELLOGG CO. has announced the election of H. R. Austin as president of the company to succeed M. W. Kellogg who becomes chairman of the board. F. E. Johnson was named vice-chairman and L. H. Harvison executive vice president. Creation of these last two executive positions was made necessary, it was explained, by the company's proposed expansion plans of industrial engineering, manufacturing and process development. The program calls for extended study of the commercial possibilities of the new processes, equipment and materials developed in connection with Kellogg's work on the atomic bomb project at Oak Ridge, Tenn.

Square D Builds New Plant

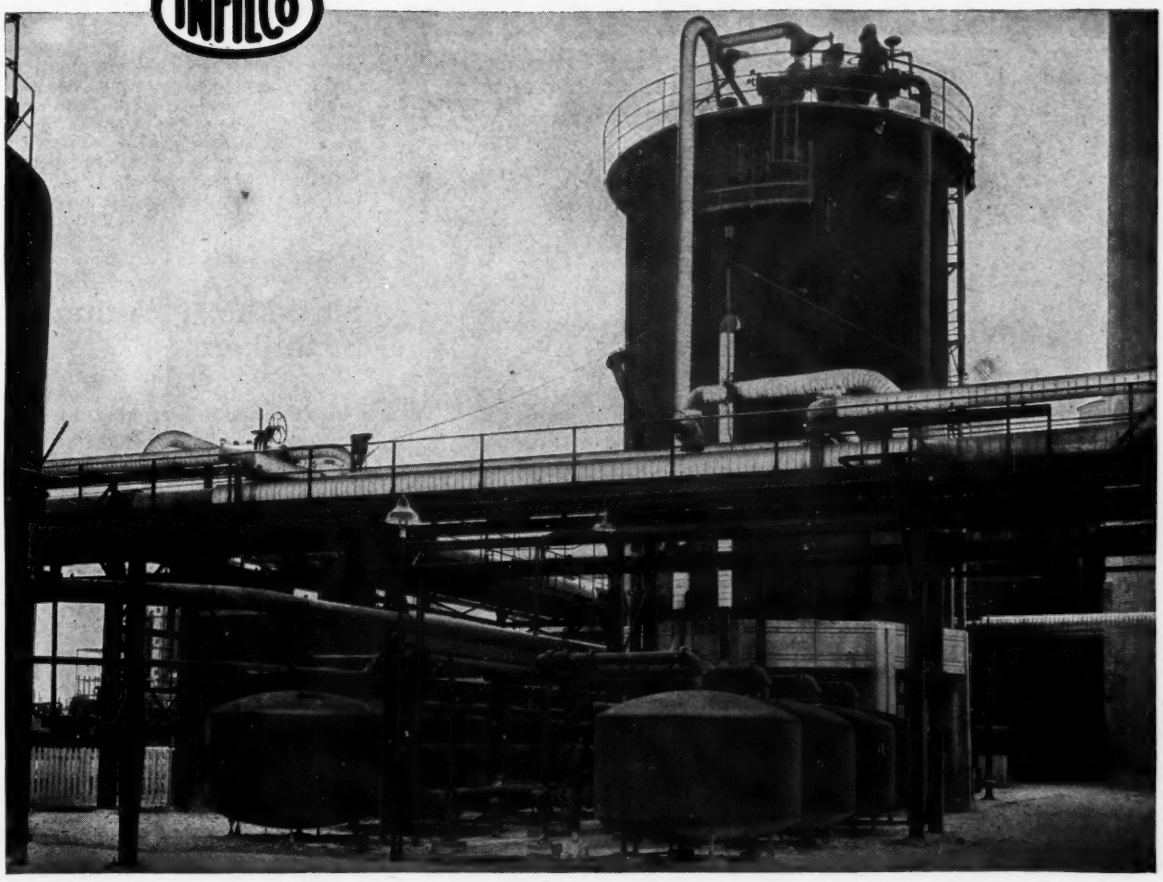
SQUARE D CO. will build a new West Coast Division plant in Los Angeles for the manufacture of control and electrical distribution equipment to replace the one now in operation it was announced recently.

The new one-story plant of brick, concrete and steel construction will expand by 60 per cent the present facilities. Construction is progressing as necessary building materials become available under current regulations. The present Los Angeles plant at 1320 East 16th Street will be disposed of.

National Radiator Purchases Plant

THE NATIONAL RADIATOR CO. has purchased the Pullman-Standard Car Co. plant at Middletown, Pennsylvania, it was announced recently. The

INFILCO



How this plant met *emergency* demands for carefully treated boiler feed water...

Another unusual test of Infilco performance.

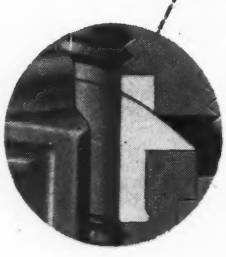
Soaring demands for boiler feed water pushed the Infilco installation pictured above to *sustained* operating rates of 115% of capacity . . . and at times to higher rates. That steady, above-capacity schedule was maintained by a large oil refiner. During the emergency period, treated water continued to be uniform. But there's more to be told about this record.

Behind this record was careful control over operations—plus clock-like performance of the equipment used. There was automatic proportioning and application of chemicals with Infilco Chemical Feeding and Proportioning equipment . . . zero oxygen content of raw-treated water and condensate with Infilco Internal Deaeration . . . thorough pre-treatment with the unique design of the Infilco Hot-Flow Sedimentation Tank. These are some of the reasons why Infilco Hot-Flow installations produce soft, non-corrosive, non-scaling water . . . for regular and emergency demand.

Unusual demands such as this may not arise overnight—often. But when they do, it's important to have water treating equipment that will meet the test. Write for Bulletin 1850. Infilco Inc., 325 West 25th Place, Chicago 16, Illinois.

CONSULT INFILCO — FIRST IN WATER AND TRADE WASTE TREATMENT

The Demand is for DART



BECAUSE IT HAS TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT

More and more users are learning the economy of buying the union that never gives up. Because of its two bronze seats, which are ground to a true ball joint, a Dart Union closes and opens as readily on its second, third or fourth job as it does on its first. Body and nut are of high-test air-refined malleable iron—practically indestructible.

It pays to ***standardize*** on Darts.

E. M. DART MANUFACTURING CO.
PROVIDENCE 5, R. I.

DART UNIONS

plant will fabricate steel boilers for industrial and domestic purposes, pressure vessels, heat exchangers and other industrial products, formerly made at the firm's Lebanon plant.

The Middletown property has upwards of 300,000 sq ft of floor area which will allow the company to increase its production of equipment used in the heating, chemical, petroleum and processing industries. The entire plant will not be put into operation at once due to needed reconversion. When working full capacity it will employ in the neighborhood of 1,500 people.

Blaw-Knox Acquires Supertherm

ARRANGEMENTS have been completed whereby the Blaw-Knox Co., Pittsburgh, takes over from the J. O. Ross Engineering Corp., New York, all engineering, sales, fabricating and installation of the Ross Supertherm Hot Water Heating System in North and South America.

Corning Acquires Plant

CORNING GLASS WORKS and the War Assets Administration have reached an agreement, subject to certain remaining conditions, for the sale to Corning of land and buildings owned by the Government at Parkersburg, West Virginia. This plant has been operated during the war by Corning Glass Works.

The acquisition of this plant will afford Corning an opportunity to install additional production facilities and to allow for expansion of manufacturing operations.

Built in 1942 by Corning for the Defense Plant Corp., the plant has been operated ever since by the company. During the early war years optical glassware for range finding instruments, fire control equipment, binoculars, telescopes and aerial photographic equipment was manufactured here.

Square D Reports

THE ANNUAL REPORT to stockholders of Square D Co. reveals that the company's sales totaled $40,300,000 in 1945 which was approximately the same as in 1944 but a decrease of 11.6 per cent from the all-time high of 1943.

It was reported that electrical divisions of the company have the largest backlog of orders in their history and that a survey of residential requirements, rural electrification and industrial projects throughout the country leads the company to be optimistic about future sales, at least for the next few years.

Sterling's West Coast Office

THE STERLING ENGINE CO., Buffalo, N. Y., has opened a direct factory branch in San Francisco, it was announced recently. The new factory branch, established to handle expanding business in the Pacific Coast states, will serve the territory west of the Rocky Mountains, and will give the Sterling Co. a coast-to-coast sales and service organization.

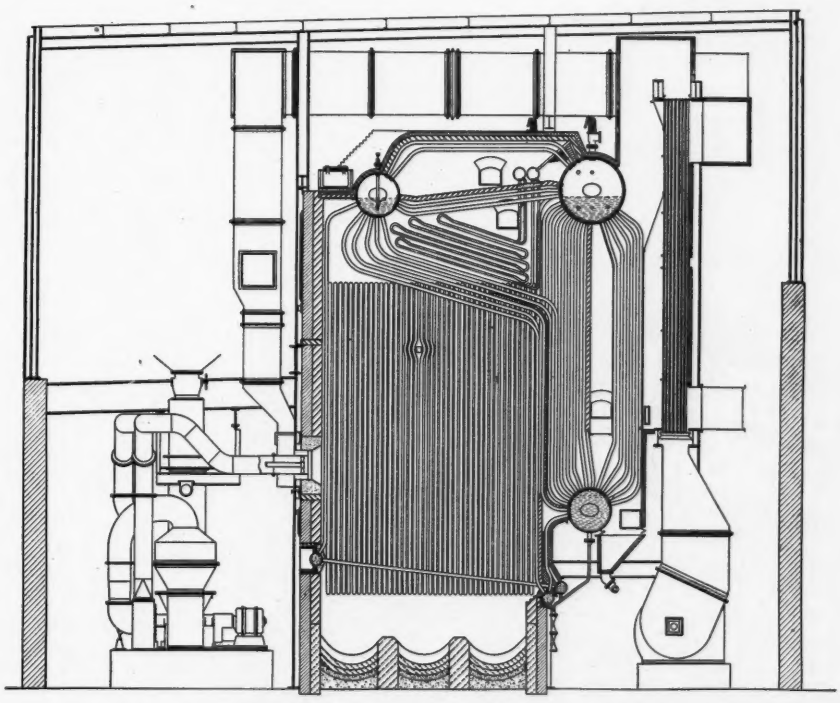
Edge Moor Radiant unit design embodies all the advantages of a 3-drum boiler with a water cooled furnace and maximum boiler tube surface exposed to radiant heat, all in a minimum of space.

This arrangement provides for large water storage, a generous steam liberation surface and a quiet offtake drum. Furnace cooling is disposed for a minimum of maintenance requirements and the best operation for the particular fuel to be burned.

The ability of the Edge Moor Radiant Heat Boiler to steam quickly and to deliver continuous high ratings is a matter of record. It is available in all sizes and pressures, and is adaptable to all fuels.

EDGE MOOR IRON WORKS, Inc., Main Office and Works, Edge Moor, Del. Branch offices: New York 1, N. Y., Empire State Building; Chicago 2, Ill., One No. LaSalle Street.

EDGE MOOR
RADIANT HEAT BOILER



Edge Moor radiant heat unit arranged for pulverized coal or liquid fuel firing. Equipped with superheater and Edge Moor vertical tubular air preheater.

EDGE MOOR
steam generating equipment

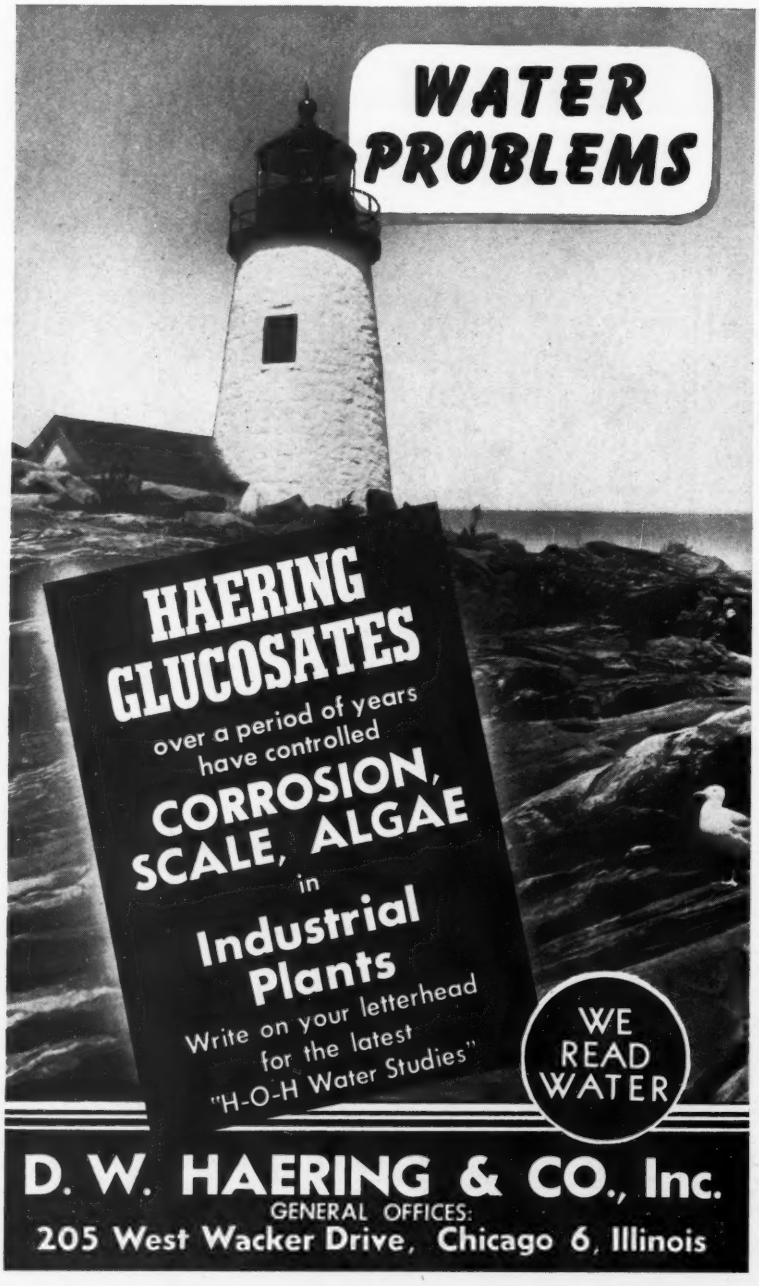
Hans Bohuslav, Vice-President and director of Sterling's engineering development and research, will be in direct charge of the new factory branch. He will be assisted by Al Hahn. Headquarters will be in the Russ Building.

Sturtevant Reorganized

FACILITIES FOR production of the first industrial and commercial air conditioning systems to be wholly engineered and manufactured by one company were reported by Gwilym A. Price, president of Westinghouse Electric Corp.

To achieve these new systems the manufacturing and engineering facilities of the B. F. Sturtevant Co., purchased by Westinghouse in September, 1945, are being integrated with the facilities of the Westinghouse Air Conditioning Division which has been transferred from Jersey City to the Sturtevant main plant at Hyde Park, Boston.

Ellis L. Spray, is executive vice president of the new organization. G. C. Derry, has been elected vice president and general manager, and is responsible for the over-all operation of the business of this subsidiary, and E. B. Williams, vice president, has responsibility for continued development of the power and marine activities of the new subsidiary.


WATER PROBLEMS
HAERING GLUCOSATES
over a period of years have controlled
CORROSION, SCALE, ALGAE
in
Industrial Plants
Write on your letterhead for the latest "H-O-H Water Studies"
WE READ WATER
D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive, Chicago 6, Illinois

MANUFACTURERS' *Personals*

Robins Conveyors, Inc., a division of Hewitt Rubber Corp., has announced that R. W. Eichenberger, vice president, has moved to the Chicago office to supervise sales in the Western division. He succeeded J. F. Meissner, who has resigned.

Harold P. Richmond, former general superintendent of operations for the Jersey Central Power & Light Co., Asbury Park, N. J., has joined the New York office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., as central station representative specializing in all steam and gas turbine matters. Mr. Richmond became associated with the utility operating field in the summer of 1928 when between his junior and senior years at Worcester Polytechnic Institute he was employed by the United Electric Light & Power Co., New York City, now the Consolidated Edison Co.

Fred H. Paulson and Curtis H. Weissinger have been appointed sales engineers in the refractories division of Norton Co., Worcester, Mass. Both will have their headquarters at the Worcester office.

Ralph Gibbs, has been appointed Director of Research of York-Shipley, Inc., York, Pa. York-Shipley is planning to enlarge the facilities and activities of its Research Department.

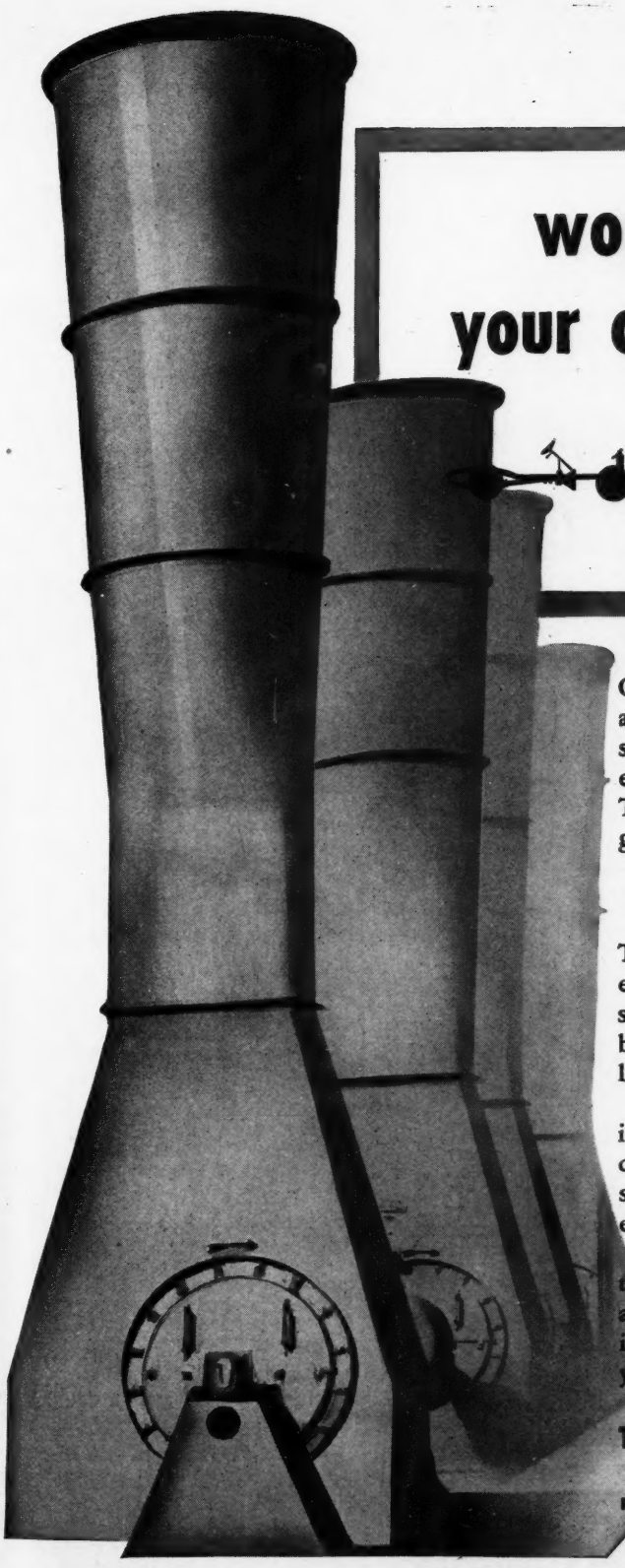
B. Gordon Valetine, has been appointed Chief Engineer of the Sterling Engine Co. of Buffalo, N. Y., it was announced recently. His professional career has been devoted entirely to the design and application of internal combustion engines — particularly Diesel engines — for stationary, marine, locomotive and tractor installation.

L. C. Kroes has been appointed manager of the Central Regional Sales according to a recent announcement by Detrex Corp., Detroit.

At the annual meeting of the board of directors and stockholders of the Wheelco Instruments Co., Claude A. Gates, New York City, manager of Zone 1, was appointed vice president; C. H. Joy, Cleveland, manager of Zone 2 and at present a director was appointed vice president; R. A. Schoenfeld, Chicago, manager of Zone 3 and at present a vice president was named a director of the company while Chas. L. Saunders, vice president was appointed to the office of executive vice president.

Sidney C. Palmer has been named manager of the Marine and Transportation Divisions, and Frederick S. Bacon, Jr., manager of the Central Station Division, for the New England District of the Westinghouse Electric Corp., it was announced recently. Both will be located in Boston.

Boyd Watson, district manager of the New York office of the Spang-Chalfant Division of The National Supply Co., will retire May 1 after 41 years with the division and its predecessor, Spang Chalfant, Inc. W. J. Stanton, who has been with the company for 14 years, will succeed Mr. Watson. Mr. Stanton was the



would you buy your car in 3 parts?

Of course not! A car is *one complete unit*—and that's exactly what your induced draft system *should* be to assure maximum total efficiency. Moreover, that's what the THERMIX *INTEGRAL* FAN STACK gives you

FAN—BREECHING—STACK
In One Integral Unit

The installation of this three-in-one stack eliminates both expensive stack supporting structures, as well as conventional fan-to-stack breeching, where so many costly draft losses occur.

A further advantage of the Thermix Stack is inherent in its divergent structure which converts dynamic gas energy into necessary static pressure. Maximum operating efficiency is thus assured.

Let a Thermix field engineer explain how these Thermix Stack advantages can be applied to your particular problem . . . to increase production efficiency and save you money.

THERMIX ENGINEERING COMPANY
Project and Sales Engineers
FIRST NATIONAL BANK BUILDING, GREENWICH, CONN.

PRAT-DANIEL CORPORATION
EAST PORT CHESTER, CONN.

company's liaison representative in Washington from 1941 throughout the war.

Richard F. Garretson was recently appointed Eastern Regional Manager of Ransome Machinery Co., Industrial Division, a subsidiary of Worthington Pump and Machinery Corp. He is in charge of sales of welding and work positioning equipment with offices at 2905 North Broad Street, Philadelphia, Pennsylvania.

The Taylor Instrument Co., has announced the appointment of N. B. Nichols as director of its Research Division. He succeeds Dr. H. L. Mason who resigned to accept the professorship of Mechanical Engineering at Iowa State College, Ames, Iowa. Mr. Nichols has, for the past four years, been associated with the Radiation Laboratory, Cambridge, Mass., a subsidiary of the Massachusetts Institute of Technology.

The appointment of Frank C. Cline as manager of the Southwestern District of the Westinghouse Lamp Division has been announced. Mr. Cline has been acting manager of the District since last July 1.

Tube Turns, Inc., Louisville, Ky., has announced the appointment of James H. Withers as district manager in charge of the firm's San Francisco and Los Angeles offices. He will divide his time equally between the San Francisco office, at 2611-12 Russ Building and the Los Angeles office, at 1625 South Hill Street.

The Terry Steam Turbine Co. announces the appointment of Glenn C. Barnaby, with offices in the Rialto Building, San Francisco, Calif., as district representative in the San Francisco area.

D. O. Bayless, Houston, Texas, has been named special factory service engineer for Southwestern United States by Edward Valves, Inc. He will have headquarters in Houston and will service Edward users throughout the Southwest and assist Edward sales representatives on specific projects.

Appointment of William P. Loyzelle as American Locomotive Co. traffic manager for all divisions except the Railway Steel Spring has been announced. Headquarters will be in Schenectady, N. Y.

Frank M. Urban has been appointed merchandise manager of the mechanical goods division of United States Rubber Co., it was announced recently.

F. A. Sarcone, Hall Laboratories engineer in water chemistry, has been transferred to the company's St. Louis staff, to be identified with service work in the St. Louis and Kansas City areas, it was announced. Mr. Sarcone will service Hall Laboratories clients in the states of Nebraska, Kansas and Oklahoma, as well as do a limited amount of work in the St. Louis area.

Daniel R. Seagrave has been appointed superintendent of service and erection in the Seattle district of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., succeeding the late R. C. Norman, according to recent announcement.

Westinghouse Electric Supply Co. has announced the appointment of Roy L. Brown as manager of its Eastern district, with headquarters in New York City. Branches included in the district are: Newark, Trenton, Jamaica and Hempstead.

L. J. Wing Mfg. Co., New York City, announces the appointment of Harang Engineering Co., 840 Lake street, San Francisco 18, as representatives for northern California.

The Helicoid Gage Division, American Chain & Cable Co., Inc., announces the appointment of R. H. Brown & Co., Portland, Ore., as its representative in that city.

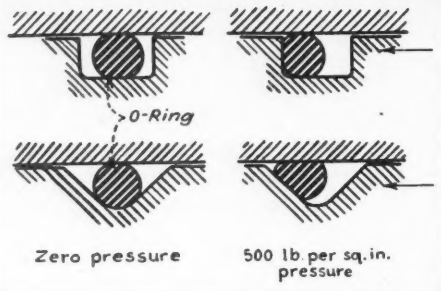
Dr. Austin W. Fisher and Dr. Bruce S. Old have joined the staff of Arthur D. Little, Inc., Cambridge, Mass. Dr. Fisher will supervise chemical engineering research while Dr. Old will engage in metallurgical research.

Col. Malcolm C. Durbin, formerly with the Army Air Forces at Wright Field, has become associated with Chicago Metal Hose Corp. Col. Durbin will serve as staff project engineer for the company.

Homer W. Northrup, formerly with the Crane Co., has recently joined the Chicago technical section of The International Nickel Co., Inc. He will be associated with the foundry activities of INCO in the Chicago territory.

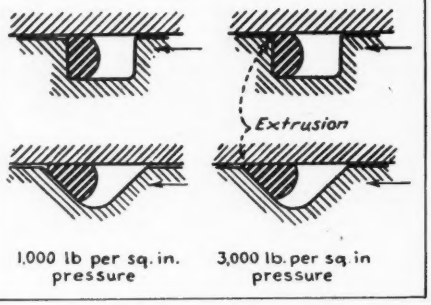
Appointment of **Edward J.** Dudley as public relations representative of the American Locomotive Co. at Schenectady has been announced. Mr. Dudley's appointment completed a reorganization and expansion of American Locomotive's public relations activities, including advertising, publicity and sales promotion.

Don't Overlook "O" RINGS in Your Search for Efficient Packing . . .



Low cost and reliable performance under extreme conditions are qualities that recommend Goodall "O" Ring Packings for a wide variety of installations. Our engineering department will cooperate in determining their application to your existing equipment or new design.

"O" Ring Packing is round in cross-section. It operates efficiently at temperatures from zero to 300° F., in air cylinders and hydraulic oil and water cylinders at pressures up to 1000 lbs. per square inch. It forms a perfect static seal at pressures up to 3000 lbs. p.s.i.



Goodall "O" Ring Packing is manufactured under exacting supervision to close tolerances. Basic materials are Buna and Neoprene, compounded to specifications covered by Christensen U. S. Patent No. 2,180,795.

Other Goodall Packing of proven quality includes Pump, Valve Stem, Lip, V-Ring and Sheet for every type of service . . . "Engineered to Your Job."

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Factory—Trenton, N. J. Established 1870

Here's why ALDRICH-GROFF "POWR-SAVR" PUMPS *actually* SAVE POWER

In medium and high pressure services—

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- ***Process Charging***
- ***Pipe Line Pumping***
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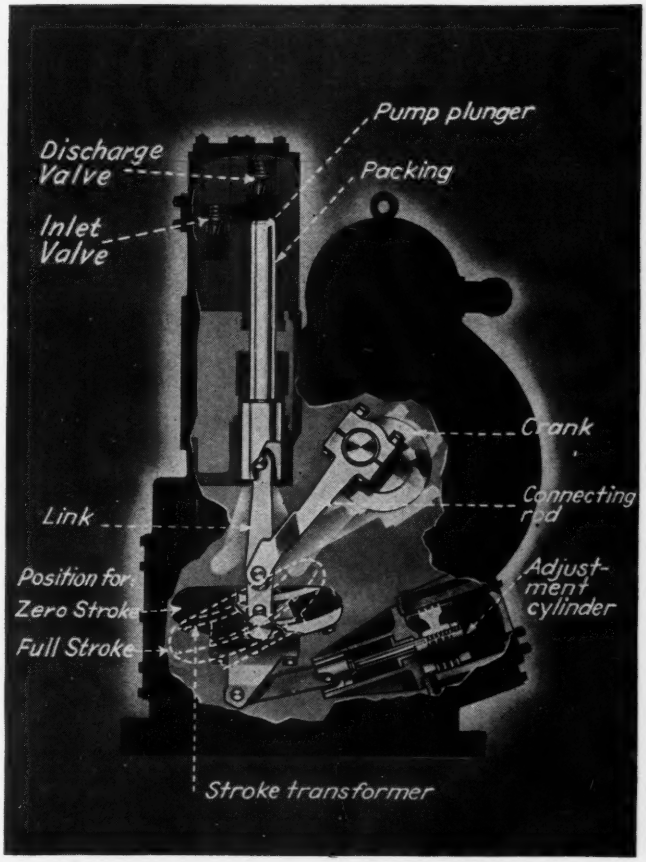

Length of plunger stroke is governed by position of stroke transformer. At zero delivery, link has pendular motion and plunger does not move. As stroke transformer is rotated toward full delivery position (shown by dotted lines) vertical component of linkage increases until full stroke is obtained. Thus, no change in pump speed is required to vary pumping capacity.

Because these unique constant-speed variable-delivery pumps are designed to afford flexibility of capacity so that power consumption is practically proportional to delivery demands, substantial savings are assured. And, a self-contained dustproof lubrication system automatically provides oil supply under constant pressure to all bearing points —assuring continued high efficiency and low maintenance expense.

Where it pays to invest money for the efficient combustion of fuel and generation of power, or for economical process equipment, it is equally important and financially attractive to utilize power with a comparable degree of efficiency. It is the function of the ALDRICH-GROFF Pump to most efficiently utilize pumping power, particularly where variable rates of pumping are involved.

These pumps may be automatically or manually controlled from any remote point of control to provide stepless straight line variation ranging from zero to full delivery. They are adapted for operation with any standard automatic controller of the "air pilot" type responsive to variations in liquid level, flow, temperature, pressure or other desired conditions.

Now available in six standard sizes ranging up to 100 B.H.P. and for pressures up to 15,000 PSI, ALDRICH-GROFF Pumps are being increasingly used wherever power savings, extreme mechanical reliability and simple accurate control of delivery is important. Since being announced in 1939, more than 300 of these pumps have been placed in varied services and have established enviable performance records under severe and exacting service conditions.

For a more detailed description of ALDRICH-GROFF principles write for Bulletin 65.

ALDRICH

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New ENGINEERING BOOKS

Electrical Protective Equipment and Power-Factor Correction by E. S. Lincoln; First Edition; 242 pages; 5½ by 8½ inches; illustrated; cloth; published by Essential Books, 270 Madison Ave., New York, N. Y.; 1945. Price $3.00.

Here is a book that covers completely the fundamentals of electric circuit protection against overloads, reverse currents, under and over voltage by means of fuses and circuit breakers. Detailed description of protective equipment, instructions for proper protection of all electrical equipment and circuits are given. The book starts out with a general consideration of the requirements of electrical protection, discussing operating principles, over-current protection, fuses, time delay, high voltage fuses, accessory fittings and instrument fuses. Next is included a chapter on Air Circuit Breakers and another one on Thermal Overload Protective Devices. There is an unusually complete chapter dealing with Magnetic Air Circuit Breakers and this is followed by a chapter on Circuit Breaker Ratings. Small Magnetic Circuit Breakers are treated in a separate chapter and there is another chapter dealing with the general subject of Oil Circuit Breakers. Of value to the electrician who has to install protective devices is a chapter dealing with the proper location of protective devices. There is also a chapter dealing with Protection Against Static Electricity and two chapters dealing with the Maintenance of Fuses and Cutouts and the Maintenance of Circuit Breakers. Fire Protection and Fire Fighting Equipment together with a chapter on Power Factor Correction conclude the book.

The Simple Calculations of Electrical Transients, by G. W. Carter; First Edition; 115 pages; 6½ by 8¼ inches; cloth; published by the Macmillan Company, 60 Fifth Avenue, New York 11, N. Y.; 1945. Price $1.75.

The aim of this little book is to supply a link between algebra and calculus and the circuit problems of our working life. The emphasis is on the physical or engineering side, special attention being given to explanations of how the circuits work. As little previous knowledge as possible has been assumed but some knowledge, which must be taken for granted, has been summarized in four appendices.

The ground covered is limited to the behavior of linear circuits with lumped element, but within these limits the treatment is through. No new step is introduced without being followed by worked examples, and these examples have all been drawn from real engineering or laboratory problems.

The book, of course, is not a simple book. It is a book which can appeal only to the people who have had sufficient background to understand it. It seems that most electrical engineers are aware that electrical transient problems can be solved by a mathematical method named after Oliver Heaviside. But the very fact that the method is mathematical puts it into a field in which many of them have practiced little since their college days. The aim of this book is, therefore, to supply the link between the algebra and the calculus of their youth and the circuit problems of their working life.

How to Find a Short and Other Automobile Wiring Troubles, by Jack Steele: 209 pages, 5½ by 7½ inches; cloth; published by the Norman W. Henley Publishing Co., 17 West 45th St., New York 19, N. Y.; 1946. Price $2.00.

This is an easily understood book written in a clear, simple style with no confusing technical language. It gives you the answers to all the light and wiring problems common to the modern automobile. It tells you how to trace down the troubles and what to do when you have found them. Do you know why a battery in a car runs down overnight? Do you know what to do when a short occurs in a car? How to trace the short down? Do you know how to install sealed beams, heaters, horns, fog lights, headlights, relays? Would you know what to do when the headlights cut off suddenly without any apparent reason when the complete electrical system in an automobile cuts off intermittently? It is questions such as these that Mr. Steele answers in this book. Anyone, any mechanic who drives an automobile, or who has to service them, will find this book of interest.

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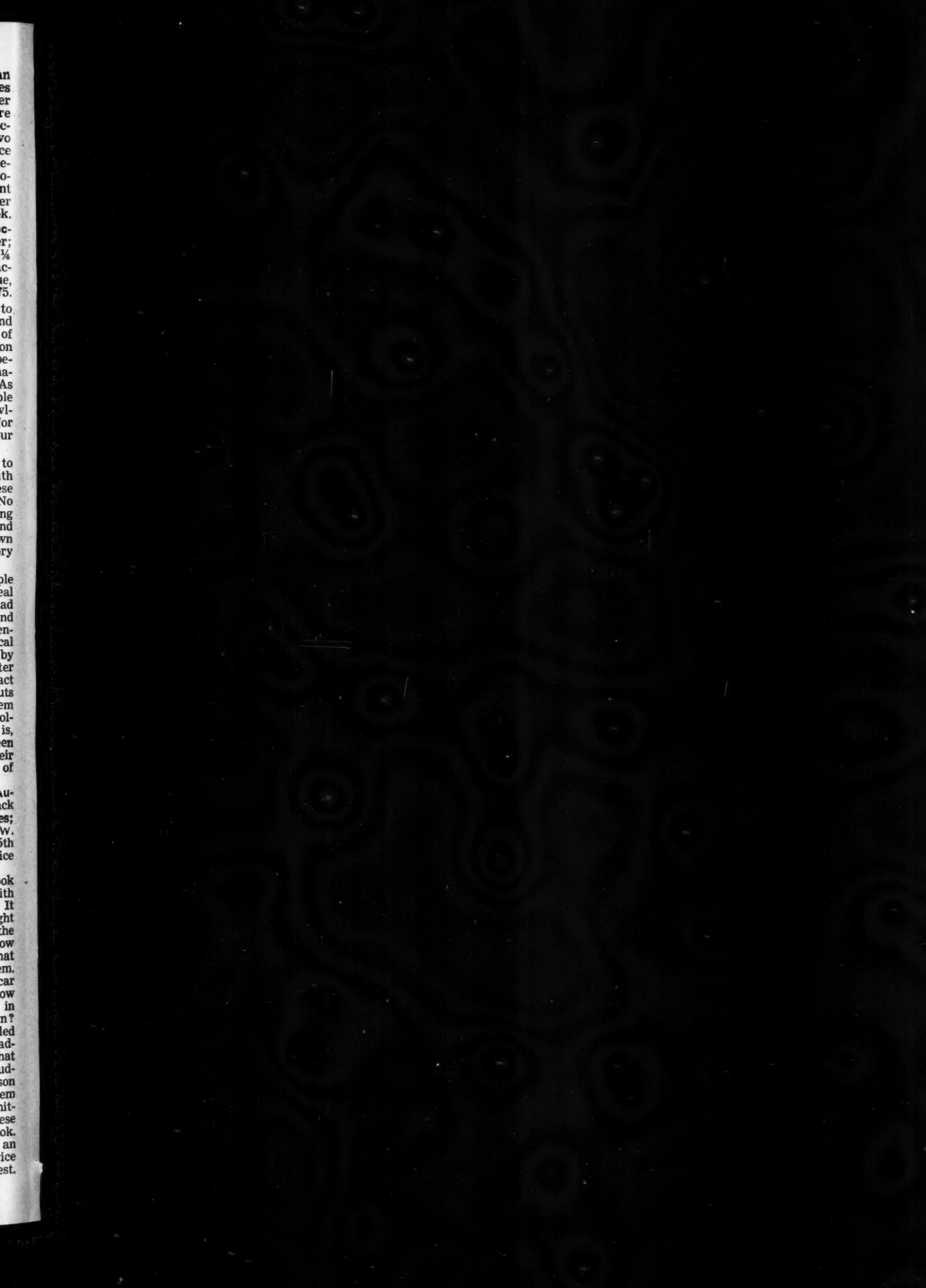

(Continued from page 36)

47 **Refiner for Dirty Oils**—Describing how substantial savings in oil and machinery maintenance costs may be obtained is the purpose of this 4-page bulletin. It describes this company's Unit Charge Oil Refiner and tells how purification of oil may be obtained by its use. The booklet goes on to show how all types of industries and plants can effectively use the refiner. Youngstown Miller Company.

48 **Concrete Chimneys**—This 32-pg. paper bound booklet is a small-size encyclopedia on chimneys and their construction, history and design of the chimneys; it covers tapered concrete chimneys, continuously-poured chimneys, foundations, vertical, horizontal reinforcement, lining, special lining, superimposed chimneys. It tells about combination coal silos and chimneys, earthquake designs. Many photos of existing installations are shown and a table of sizes for various boiler horsepowers is presented. Alphons Custodis Chimney Construction Co.

49 **Steam Trap Handbooks**—Catalog H contains tables, charts, diagrams and rules for selecting traps, giving complete explanations, makes the new 36-pg. book a handy reference volume for every engineer's library. Armstrong Machine Works.

50 **Fuel Oil Heater Handbooks**—The Whitlock Manufacturing Co. has just released a new Bulletin No. 35 featuring its line of fuel oil heaters. Included is a handy viscosity-temperature chart which shows at a glance the temperature required to reduce oil to the desired viscosity; also capacity tables and other handbook data.

51 **Tank Construction Handbook**—New Downington Catalog No. 102 illustrates some tanks, turbine scroll cases, heat exchangers and other fabrications by Downington. Also contains facts about ASME code for unfired pressure vessels, capacity table and other handbook information. Downington Iron Works.

CATALOG LIBRARY

This department will appear each month and the bulletins listed herein will also appear each month with the exception of additions and minor changes made at the request of the manufacturers who issue the catalogs. Use card below or on page 35.

PRIME MOVERS

52 **Wheel Turbines**—Explanation of 14 advantages; diagrammatic illustrations and explanations of operation; 8 pages. Terry Steam Turbine Co.

53 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. Terry Steam Turbine Co.

54 **Multi-Stage Turbine**—Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

55 **Steam Engines**—Bulletin No. 306: Engineering data, tabular material descriptions; 8 pages. Troy Engine & Machine Co.

56 **Generating Sets**—Bulletin No. 108: General descriptions, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

STOKERS

57 **Stoker**—Catalog H; Type H stoker; cross-sectional installation drawing; features of ash discharge; typical installations; 10 pages. American Engineering Co.

58 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings, ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 pages. American Engineering Co.

59 **Water-Cooled Stoker**—Catalog W; drawings of installations; features; furnace views; 8 pages. American Engineering Co.

60 **Spreader Stoker**—Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

61 **Pneumatic Spreader Stoker**—Threefold booklet on the inner page of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

62 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, fan capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

OIL, GAS BURNERS

63 **Oil Burning Systems**—Bulletin 45-1; three types of systems; drawings, tables of capacities and descriptions; photos; 4 pages. Faber Engineering Co.

64 **Mechanical Oil Burners**—Bulletin 45-2; two systems; drawings, tables of capacities and descriptions of units; parts list; 4 pages. Faber Engineering Co.

65 **Oil and Gas Burners**—Bulletin 45-3; combination burner; photos, drawings, tables; 4 pages. Faber Engineering Co.

66 **Wide Range Oil Burning System**—Bulletin 109; How the system operates; control; drawings; 4 pages. Peabody Engineering Corp.

67 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

68 **Gas Burners**—Bulletin 203; description of A and H gas burners; cross sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

69 **Gas and Oil Burners for Oil Refinery Furnaces**—Bulletin 702; details of firing with gas, with oil; photos; drawings; 4 pages. Peabody Engineering Corp.

WATER TREATMENT

70 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Co., Inc.

71 **Industrial Water Treatment**—Microbiological Control of and Through Industrial Waters; spot summaries of improvement of process efficiency and product quality by proper sterilization. Wallace & Tiernan Co., Inc.

72 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important considerations in chemical treatment of cooling water circuits. Wallace & Tiernan Co., Inc.

73 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Co., Inc.

74 **Index for Calcium Carbonate**—Reprint of paper by John W. Ryznar; tables and charts; 16 pages. National Aluminate Corp.

75 **Water Treatment**—Bulletin 28S; Scale retardent for use in boilers, feedlines, heaters, etc.; drawing of points of application; composition; 4 pages. National Aluminate Corp.

76 **Boiler Feedwater Q & A**—Bulletin 30; 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

77 **Water Analysis**—Bulletin 6A; standard methods of water analysis and interpretation of results; 4 pages. National Aluminate Corp.

78 **Water Treatment**—Scale and corrosion control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

79 **Algae and Slime**—Bulletin 31; the elimination of algae and slime in cooling systems, paper mills, etc., drawings, photos; 4 pages. National Aluminate Corp.

80 **Chemical Feeding and Proportioning**—Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

81 **Water Treatment**—Various types of water treating; corrosion, carry-over; boiler scale; flexibility; rust prevention; brine treatment; softening and coagulation; cooling and condenser water; chart of treatment in various industries; 24 pages. Western Chemical Co.

82 **Water and Steam Treatment**—Two bulletins on Algaecide and Coravol; when and where algaecide should be used; tells how Coravol operates in the steam system; features and advantages; testimonials; 9 pages total. Western Chemical Co.

83 **Water Softeners**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse regulators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

POWER TRANSMISSION

84 **Chain Drives**—Bulletin 43 Engineering Data; installation and maintenance; chain types; sprocket types; drive design; horsepower capacity; shoes and idlers; sprocket diameters; miscellaneous data; directions for cutting sprockets; elec-

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tric motor shaft data; illustrations, complete indexing; 82 pages. Morse Chain Co.

85 **Roller Chains**—Catalog R44; installation; chains and parts; chain drive layout; power transmission capacity tables (10); calculation of chain length; sprocket diameters; dimensions of teeth; 94 pages. Morse Chain Co.

86 **V-Belt Drives**—For fractional horsepower service; features; full pages of tabular material and directions on selecting proper drive; reference table on standard pulley combinations in sequences of pulley sizes; overloads and peak loads, general engineering data; prices and dimensions; 42 pages. The Dayton Rubber Mfg. Co.

87 **V-Belt Drives**—Catalog 280-A; 15 pages on V-belt drives for std. motor speeds; 41 pages on V-flat drives, how to select, advantages; nine pages on supplementary drive tables; 13 pages of engineering data; 16 pages prices and dimensions; total 112 pages. The Dayton Rubber Mfg. Co.

88 **Speed Reduction, Increase Gear**—Bulletin S130—description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Terry Steam Turbine Co.

VALVES

89 **Regulating Valves**—Bulletin 1-A; valve data book; description, dimensions and lists of parts; typical installations; rated capacities; prices; 52 pages. Atlas Valve Co.

90 **Pressure Regulator**—Bulletin 1-B; description, installation, operation; list prices; sectional and installation views; parts lists; 8 pages. Atlas Valve Co.

91 **Pressure Reducing Valves**—Bulletin 1-C; sectional drawings, list prices, dimensions and weights; operation and adjustment; capacities for steam and air; 12 pages. Atlas Valve Co.

92 **Float Valves, Liquid Level Controls**—Bulletin 3; description and list of parts; price lists; operation; adjustment; application and utilization; installation drawings; 8 pages. Atlas Valve Co.

93 **Pressure Reducing Valves**—Bulletin 401-A; selection of proper valve; construction; installation; capacity tables; interchangeability; dimension tables; 14 pages. Leslie Co.

94 **General Service Valves**—Bulletin E-150; valves for blow-off; fire protection, soot blower lines, acids, process, etc.; descriptions; exploded views; features; dimensions, weights and list price tables; parts and parts lists; 14 pages. Everlasting Valve Co.

95 **Valves**—Bulletin E-100; for boiler room service; photos, descriptions, parts; features; pressure rating indexes; size, shipping weight and price tables; ordering information; 30 pages. Everlasting Valve Co.

SWITCHGEAR

96 **Switchgear**—Bulletin 4508; conversion factors and formulas for electrical engineers; definitions of basic units; mensuration conversion factors; temperature conversion factors; electrical conversion factors; 8 pages. I-T-E Circuit Breaker Co.

HEATING, COOLING

97 **Cooling, Heating, Air Conditioning**—Collection of bulletins; installation, design, construction data, capacity ranges, condensed physical data; numerous photos of installations, full page color diagrams of flow of air, compressed air, water, water spray, etc.; 74 pages. Niagara Blower Co.

98 **Steam Conduit System**—Bulletin 381 and 451; tells of foundation, drainage and insulation features; covers tile envelope, pipe insulation, pipe supports, anchors, guides and saddles; photos of installations; 12 pages. H. W. Porter & Co.

99 **Fin Tube Heating**—Bulletin 11sa; Room and building heating; edr tables; correction table; dimensions and areas; 4 pages. Schutte & Koerting Co.

OIL, LUBRICATION

100 **Lubrication Recommendations**—Special oils for diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

101 **Cutting Fluids**—Facts about cutting fluids; machine tool operations; fundamentals of cutting; How to Apply; metallic cutting tools; tabular material; shop practices; 50 pages. Standard Oil of California.

102 **Diesel Operation**—Relation of fuels and lubricants to the operating efficiency in the diesel engine; diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleanliness; tabular material, charts, formulas; 114 pages. The Texas Co.

103 **Engineers Report on Oil**—Engine tests, laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

104 **Drop Forged Flanges**—Manufacturing processes; physical characteristics; full-page tables of illustrations, dimensions, weights and prices. Space provided for future insertions. Phoenix Mfg. Co.

CONTROLS, METERS

105 **Pressure Controllers**—Bulletin 402; air, gas, steam or water service; when to use; selecting diaphragm regulating valve; sizing and capacity; operation; installation; ordering; specifying; dimensions; diaphragm regulating valves; 12 pages. Leslie Co.

106 **Pump Governors**—Bulletin 403-A; reciprocating, turbine-driven, motor-driven pumps; selection of governor; construction; pressure, capacity tables; installation; sizing; specifying; dimensions; 12 pages. Leslie Co.

107 **Temperature Regulators**—Bulletin 404-A; heating or cooling service; selection of regulator; temperature and pressure ranges; installation; various types described and pictured; ordering and specifying; complete tabular material; 16 pages. Leslie Co.

108 **Damper Regulators**—Bulletin 4-A; for low pressure heating, medium pressure power and high pressure power boilers; what they do; how to specify; typical installations (drawings); adjustments; list prices; technical descriptions and parts lists; 20 pages. Atlas Valve Co.

109 **Pump Governors**—Bulletin 2-B; photos, descriptions, list prices, dimensions and weights in tables; operation and adjustment; installation drawings; 20 pages. Atlas Valve Co.

110 **Engineering Monographs**—Series of eight on automatic combustion control; 1. How Close Can Steam Pressure Be Controlled? 2. Why Operate Automatic Combustion Control from Changes in Steam Pressure? 3. Adapting to the Characteristics of Underfed Stokers. 4. Adapting to Spreader Type Stokers. 5. Adapting to Chain or Traveling Grate Stokers. 6. Adapting to the Characteristics of Pulverizers. 7. Adapting to the Characteristics of Oil Burners. 8. Adapting to the Characteristics of Gas Burners; total 37 pages. The Hays Corp.

111 **Draft Gages**—Bulletin 46-667; gages for indicating, recording of drafts, pressures, differentials, temperatures; pressure-draft tables; descriptions of equipment; differential units, Bourdon tube units, pointer gages, etc.; 20 pages. The Hays Corp.

112 **Draft**—Bulletin 46-472; what draft is; where it is found; how it is measured; what the draft gage tells; where to measure draft and pressure in steam plant; where to connect draft gages; how to install; drawings; 20 pages. The Hays Corp.

113 **Pointer Gages**—Bulletin 45-589; where and how to install pointer gages; engineering data, drawings; 8 pages. The Hays Corp.

114 **Air Filter Gage**—Bulletin 46-751; resistance through filters; price and scale range tables; types of gages; 4 pages. The Hays Corp.

115 **Flue Gas Analyzer**—Bulletin 45-669; principle of operation; construction features; technique; models and prices; Burettes—classifications and uses (table); what flue gas analysis tells us; 16 pages. The Hays Corp.

116 **Combustion Testing**—Bulletin 46-497; making combustion simple; how to run an orsat—pictures and directions; making draft survey; flue gas temperature; charts and drawings; 12 pages. The Hays Corp.

117 **Temperature Regulators**—Bulletin 7-A; six types; descriptions, list prices, tabular material, photos; lists of parts; typical installation drawings; tables for finding sizes of control valves required to heat given quantity of water; 16 pages. Atlas Valve Co.

118 **Feed Water Regulator**—Bulletin 6-A; description of operation; cycle of operation; full-page installation drawings; instructions for installing regulators; list prices and parts lists; 14 pages. Atlas Valve Co.

119 **Temperature Regulators**—Bulletin 6-A; for hot water heaters, storage tanks, etc.; what they do; operation; regulation; descriptions and drawings; list prices; applications; dimensioned drawings; installations; 20 pages. Atlas Valve Co.

120 **Draft, Excess Air and CO_2**—Bulletin 39-341; discussion of the relation of these elements to the installation and servicing of bituminous and anthracite stokers by Arnold Soller; 12 pages. The Hays Corp.

121 **Furnace Draft Control**—Bulletin 45-489; excess air and its effects; remedy; description and drawings of control; construction; how it works; 8 pages. The Hays Corp.

122 **Automatic Combustion Control**—Bulletin 46-448; relation to steam costs; advantages of efficient control; typical application; handling swing from 8000 to 25,000 lb per hr; 12 pages. The Hays Corp.

123 **Centralized Combustion Control**—Bulletin 43-605; applications to various types of fuels and burning equipment; controller, measuring elements, pilot device, power unit, etc.; 24 pages. The Hays Corp.

124 **Combusion Meters**—Bulletin 44-550; reasons why it is: accurate, dependable, simple, rugged, easy to install, easy to maintain, speedy, easy to understand; well illustrated by explanatory diagrams; 16 pages. The Hays Corp.

125 **Rate-of-Flow Measurements**—Bulletin 18-R; Rotameters, what they are, how they work; advantages; types; selection of proper unit; theory; parts list; survey sheets; gravity and sight-flow indicators; engineering data and tables; 34 pages. Schutte & Koerting Co.

(Continued on page 172)

JUNE

POWER PLANT ENGINEERING

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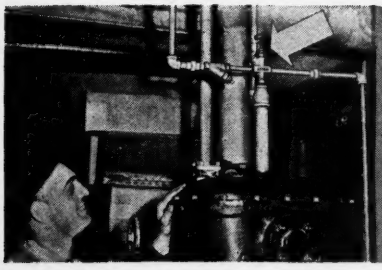

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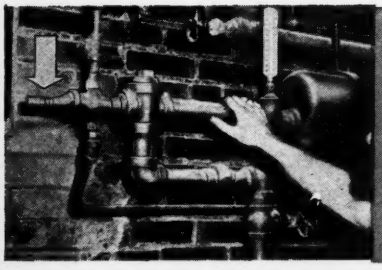
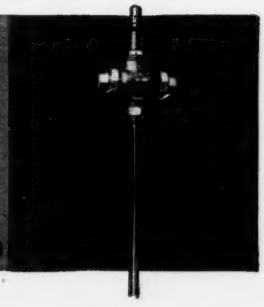
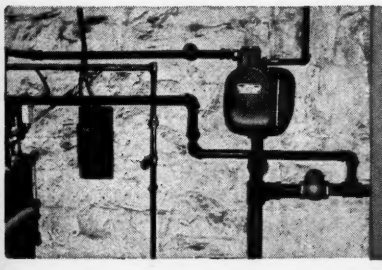


Sprinkler Tank Heating

Controlled by Sarco TR-50 rigid stem control. Uses minimum of heat. Insures enough heat to prevent freezing. Bulletin No. 600.

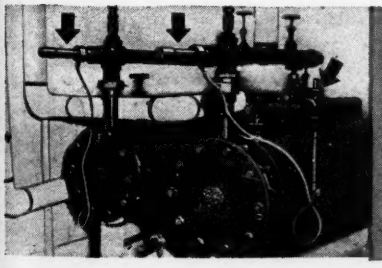
TR-50





Alternating Receiver

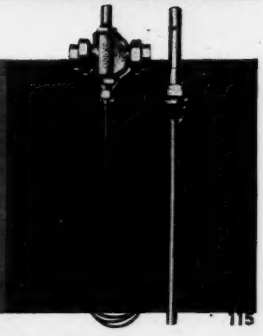
Used as a boiler return trap—or to lift condensate to higher level or pressure. It has modernized many heating systems. Bulletin No. 165.



Oil Pre-heater

Temperatures controlled within a degree by Sarco TR-21 temperature controls. No more sputtering—due to improper oil temperatures. Bulletin No. 600.

TR-21



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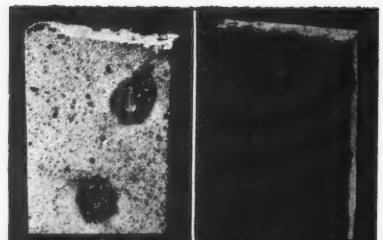

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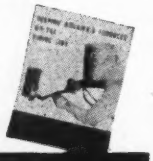

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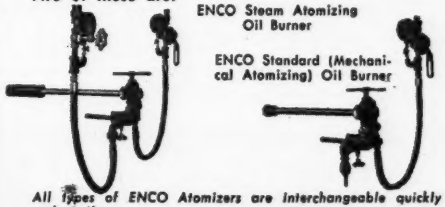

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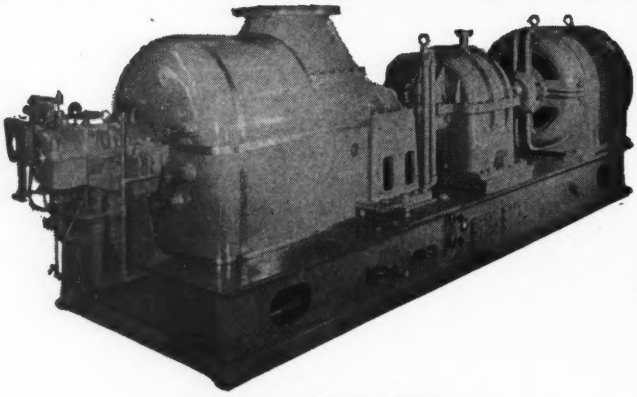

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POWER PLANT ENGINEERING

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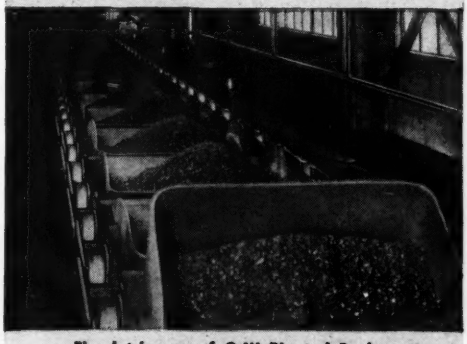
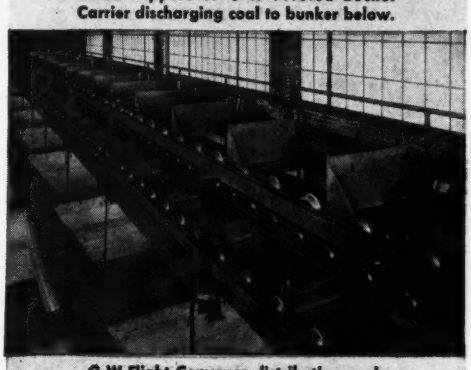


Fixed trippers of G-W Pivoted Bucket Carrier discharging coal to bunker below.



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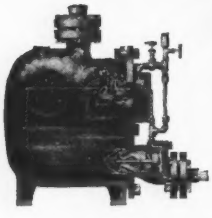

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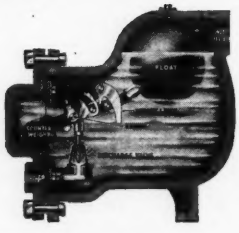

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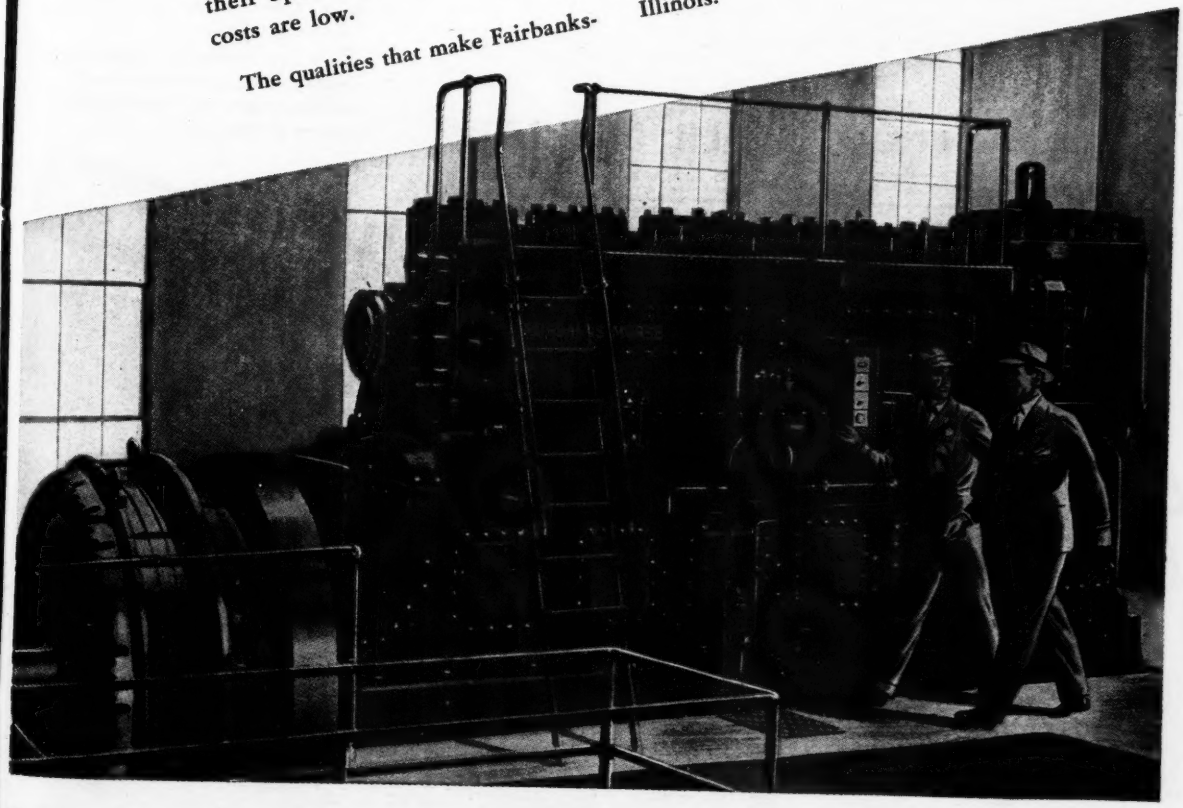

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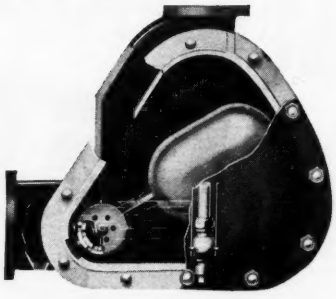

Cochrane Multiport Drainers have exceptionally high capacity at low pressure due to the large multiport areas.

They are particularly effective in carrying away heavy momentary slugs.

They are instantly responsive due to the balanced rotary valve with only one moving element and no stuffing box.

COCHRANE SINCE 1863

DRAINERS

THEY PROVIDE CONTINUOUS DRAINAGE

THEY ARE COMPACT—OCCUPY VERY LITTLE SPACE

THEY ARE SURPRISINGLY LIGHT IN WEIGHT

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COCHRANE CORPORATION
3123 N. 17th St., Phila. 32, Pa.

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Learn the secret of BIG EARNINGS in . . .
COMBUSTION ENGINEERING

There are plenty of good pay jobs in the power field today. Increase your earnings now—be a Hays-Trained Combustion Engineer. Just a little of your spare time required for the simple, easy-reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

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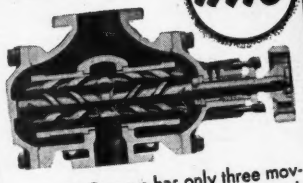
THE *PUMP* WITHOUT PISTONS, VALVES, BEARINGS, GEARS OR VANES

IMO



The IMO pump has only three moving parts—a power rotor and two sealing rotors — nothing to get out of order or to require adjustment. The IMO pump can be depended upon in hydraulic service, governor service, lubrication service and other applications in which continuity of operation and freedom from maintenance are vital.

For further information send for catalog I-131-G

IMO PUMP DIVISION of the
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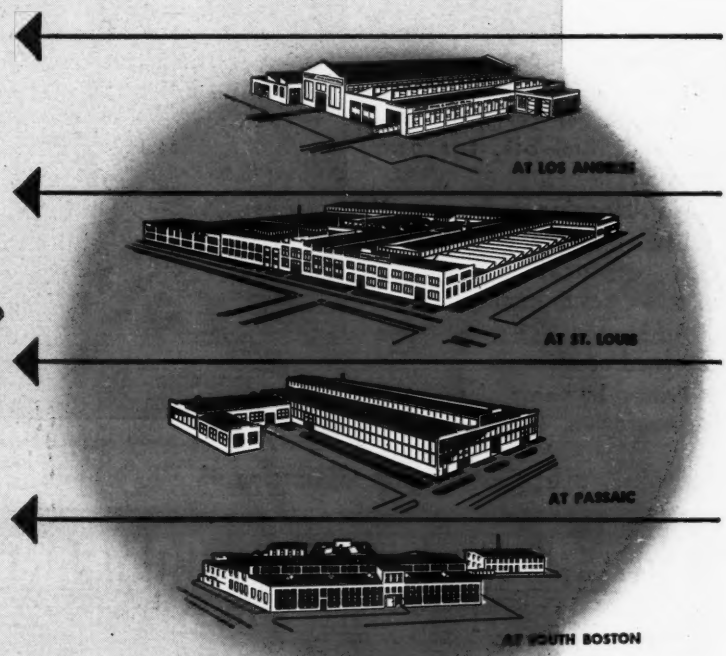
TRENTON 2, NEW JERSEY

TO THE USER OF FABRICATED PIPING

4 PLANTS *Are Better* THAN 1



There are four Midwest pipe fabricating plants located in different parts of the country, because Midwest has found that "four plants are better than one" for the user of piping.

In addition to shortening shipping distances and making for a better understanding of the customers' individual problems, four plants provide other important benefits in which all Midwest Piping users participate.

Extra reserve capacity is provided for the emergency job. If extreme speed is sufficiently important, a job can be divided among two or more plants. An overload in one plant often can be handled by temporarily transferring skilled workers from other plants.

One of the greatest advantages is the continuous exchange of information and experience between staff members of the four plants. New techniques developed in one plant are made known to all. Piping problems which may be new to one plant probably are very familiar to another where the "know how" information is available at once. Friendly rivalry—constant study of piping problems by four organizations—tends to advance the art of piping fabrication much more rapidly than would otherwise occur.

All of this works to the advantage of piping users —four plants are better than one.

Midwest can give you better piping and better service . . . whether you need only a simple bend or the most elaborate piping job completely erected and ready for operation.

1527

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Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles
Subsidiary: Lumsden & Van Stone Co., South Boston 27, Mass.
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Faber Wide Range Semi-Mechanical Oil Burners

Featuring

Unlimited range of operation without change of burners.

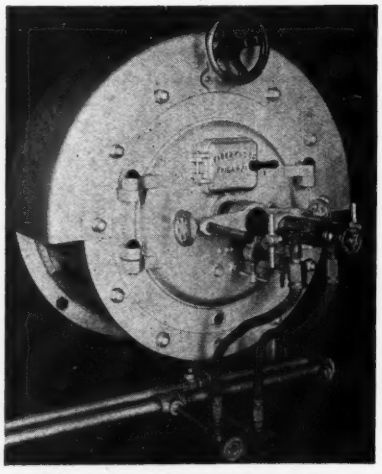
Capable of burning any grade of fuel oil, tar and residue.

Non-clogging.

Low oil pressure with efficient atomization, resulting in a low power consumption.

All heated oil burned, none returned to storage.

Proven by years of successful operation.

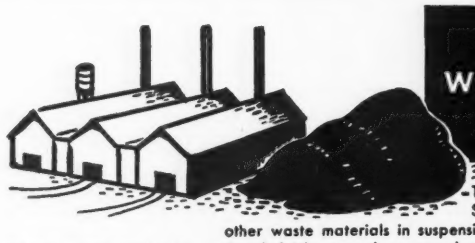


Faber Wide Range Semi-Mechanical Burner

Upon Request Catalog 45

FABER ENGINEERING COMPANY

PHILADELPHIA 34, PA.



HAVE YOU WASTE MATERIALS TO BURN?

"Burning Waste Wood in Suspension" is the title of an article by John Phillips Badenhausen which appeared in a recent issue of a technical journal. We will gladly send you a reprint on request.

The John Phillips BADENHAUSEN System for burning sawdust and other waste materials in suspension, without grates or the conventional dutch ovens, has proved a real economy through savings in fuel, installation costs and great reduction in operation and repairs.

If you have not given careful and serious consideration to the use of your waste materials for fuel, a meeting with our engineers will give you a clean-cut picture of possible great economies.

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Boilers — Firing Systems — Superheaters — Sawdust Burners — Special Installations Designed to Increase Existing Facilities

TEMPLETON RETURN STEAM TRAPS

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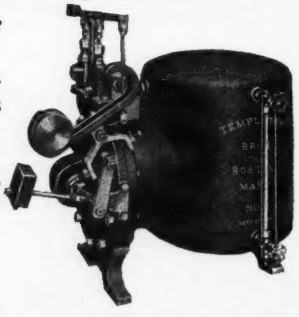
Pumps Water at any temperature or pressure.

Open float cannot burst or waterlog.

Valves and Seat Bronze or Stainless Steel.

Sizes 1 in. to 4 in. inlet and outlet.

Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.



Ask for catalogue and prices

TEMPLETON BROS., INC.

699 Main St. Walpole, Mass.

a saucer from the five and dime

a few drops of Phenolphthalein from a drug store

a few drops of Methyl Orange from a drug store

a few ounces of NCC (which we will furnish FREE)

and you can test for yourself that

NCC

SLUDGE SOLVENT

AND FUEL OIL CONDITIONER

1. Dissolves even the hardest sludge

2. Contains no caustic

3. Is acid-free

HOW TO MAKE THE TESTS

FOR SLUDGE

Place some sludge in a saucer (a scraping from the fill pipe is an easy way to get some). Add enough NCC to cover completely. Right before your eyes you will see the sludge dissolve.

FOR ACID

The accepted test for acid in a liquid is the addition of Methyl Orange which turns the tested liquid pink if it contains acid; yellow, if acid-free. NCC turns yellow, proving that it is neutral and acid-free.

FOR CAUSTIC

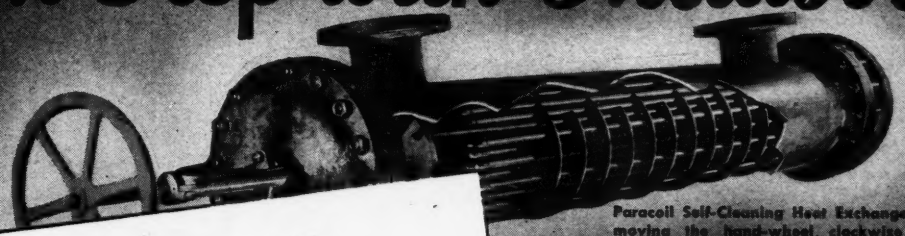
The accepted test for caustic in a liquid is the addition of Phenolphthalein which turns the tested liquid pink if it contains caustic. Into a saucer pour some NCC. Add a few drops of Phenolphthalein. NCC will remain water-white, proving that it contains no caustic.

A sample of NCC, to enable you to make these tests, will be sent postage-paid and FREE. Please write on your company letterhead.

NUTMEG CHEMICAL CO.

227 State St., New Haven 10, Conn.

In Step with Industry



Paracoil

HEAT TRANSFER EQUIPMENT

Davis Engineering Corporation has played a major part in the development, design betterment and manufacture of distillation, evaporation and heat exchange equipment for more than 30 years.

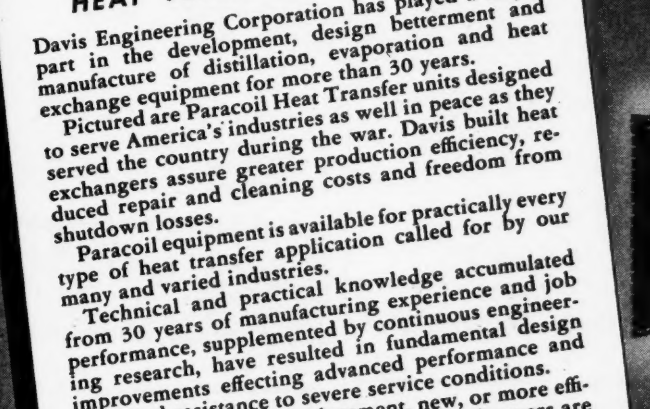
Pictured are Paracoil Heat Transfer units designed to serve America's industries as well in peace as they served the country during the war. Davis built heat exchangers assure greater production efficiency, reduced repair and cleaning costs and freedom from shutdown losses.

Paracoil equipment is available for practically every type of heat transfer application called for by our many and varied industries.

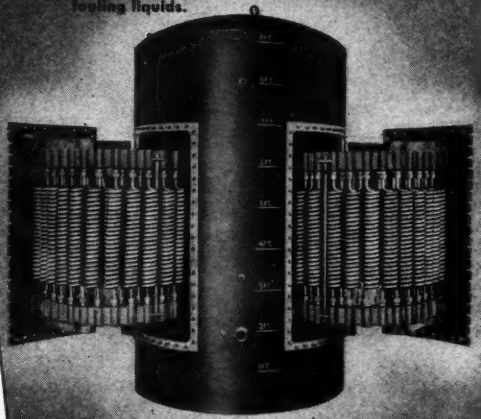
Technical and practical knowledge accumulated from 30 years of manufacturing experience and job performance, supplemented by continuous engineering research, have resulted in fundamental design improvements effecting advanced performance and increased resistance to severe service conditions.

Whether yours is a replacement, new, or more efficient equipment need, Paracoil Heat Exchangers are available on most reasonable delivery schedules and Davis engineers are ready to assist in making proper selection of size and design best suited for your particular problems.

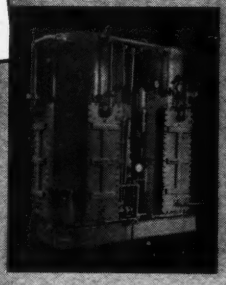
To those with fouling problems: Write for bulletin HE-100 describing the Paracoil Self-Cleaning Tubular Heat Exchanger.

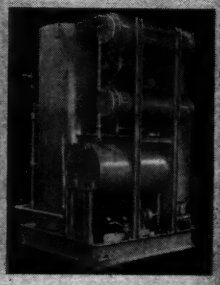


Paracoil Self-Cleaning Heat Exchanger. By moving the hand-wheel clockwise and counter clockwise the entire baffle-assembly is moved back and forth over the heating surface thus scraping any deposits from the tubes. Cleaning action is positive and effective. Ideal for heating fuel oil and other fouling liquids.



Paracoil Double-Door Evaporator. Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in single and multiple effects and in a wide range of capacities.



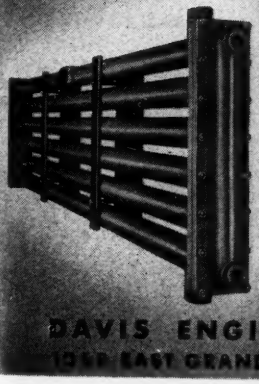


FRONT VIEW

Triple Effect Package Type Distillation plant built for supplying distilled water from sea water or contaminated water for drinking and process service. Illustrates Paracoil hinged door evaporators. A completely self contained unit.

BACK VIEW

This distillation unit has a capacity of 180 gallons per hour with low pressure steam and economical steam consumption. Other package types standardized for a number of capacities.



Gas to Gas Heat Exchanger. This type of Paracoil Heat Exchanger has many industrial uses for transfering heat between gases or liquids, or between gases and liquids. Unit illustrated constructed entirely of inconel. Can be furnished in other alloys or carbon steel.

Liquid to Liquid Exchanger. Special liquid to liquid exchanger for counter current flow, six pass on both shell and tube sides. Most efficient design for crossing temperature conditions. Straight tubes easily cleaned.

DAVIS ENGINEERING CORPORATION

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SINCE 1915

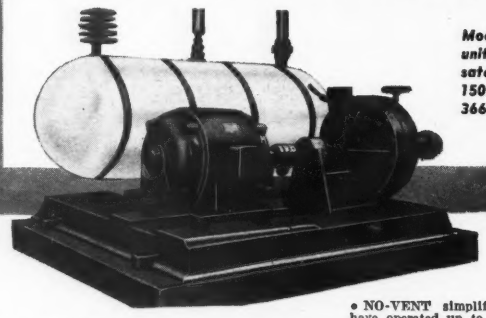
Paracoil

HEAT TRANSFER EQUIPMENT

Operate Cookers, Heaters, Driers?—Find Out How

NO-VENT STOUT RETURN UNITS

Prevent "Flash" Steam Losses—Boost Output Up to 15%



Model D-2 NO-VENT unit collects condensate from 210 bhp at 150 lb. pressure and 366 deg F

- With the NO-VENT SYSTEM the condensate is returned to the boiler as fast as formed—without the use of steam traps, vents or reheating.
- By eliminating "flash" steam loss, the NO-VENT system commonly requires only ⅛ as much make-up water as other systems.
- Better steam circulation the NO-VENT way means quicker heating of cold cookers, driers and other steam heated units—production increases up to 15%.
- NO-VENT simplifies maintenance. Many units have operated up to 6 years without expense except for electricity, lubrication and packing.
- Because it reduces the amount of make-up water needed—also prevents oxygen and non-condensibles being carried into boiler—NO-VENT helps keep boiler free from scale and corrosion.
- Actual tests show fuel savings from 10 to 35% after installing NO-VENT System.
- NO-VENTS are made in capacities 100 to 800 bhp, pressures to 200 lb. Write for bulletin showing hookup, giving operating details and guarantee chart of savings in boiler load.

HEAT RECLAIMER CORP.

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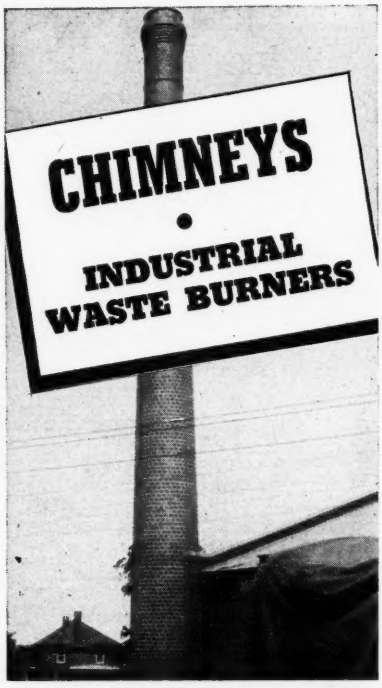
Heat Reclaimers • Steam Condensers • Spiro Water Heaters



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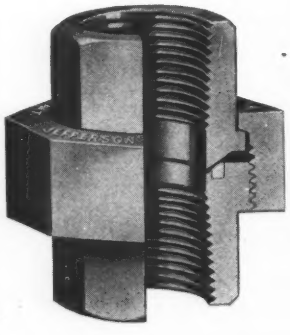

The Feature of the RECESSED BRASS SEAT in the

JEFFERSON UNION

makes it unique

It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

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601 West 26th St., New York 1, N. Y.
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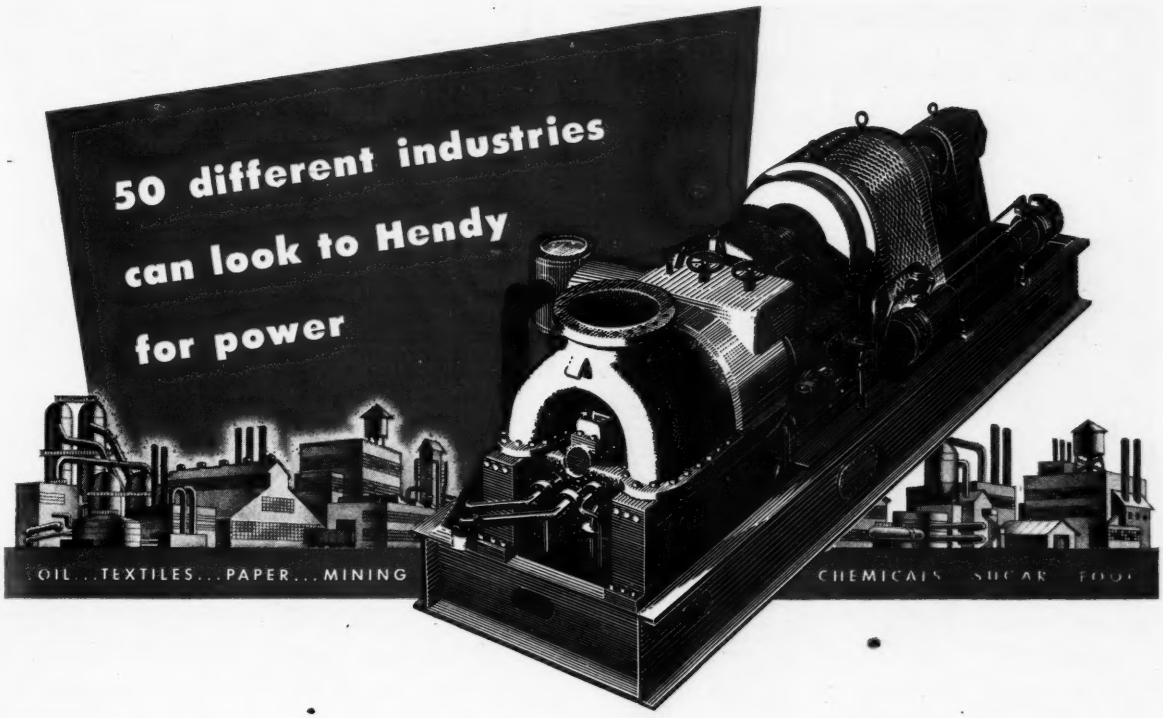
Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.



Out of the war have come many advances in the design and manufacture of power plants. The same Hendy engineers who amazed the world by their skill and speed in perfecting power for *war*, have now turned their talents to *power for peace*. For many industries—and probably yours—Hendy can supply modern power units that will mean lower-cost production for the vital, competitive years ahead. Our organization will gladly work with your engineers in preparing a preliminary survey and estimate.

WRITE FOR LITERATURE

describing steam turbines and turbo-generators, medium- and heavy-duty Diesels, and Diesel-electric sets engineered by Hendy to meet the power needs of post-war industry.

Power by
HENDY
Engineered to suit your needs

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CROCKER-WHEELER ELECTRIC MANUFACTURING COMPANY DIVISION, AMPERE, NEW JERSEY

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A VALVE THAT WILL INTEREST EVERY POWER ENGINEER

THE
DAVIS
No. 265
HIGH PRESSURE
RELIEF VALVE

for:

- Turbine relief on bleeder system.
- Protection of any boiler room or process equipment by relief to atmosphere
- Relief of high pressure lines to low pressure lines at predetermined pressure.
- Plants carrying multiple boiler pressures to protect lower pressure systems.

The Davis No. 265 High Pressure Relief Valve, an exclusive Davis design offers numerous features of advantage:

1. Multiple springs — less spring accumulation—less build-up for maximum relief — less blowdown to close.
2. Requires appreciably less head room because of compact design with springs located at sides.
3. Center adjusting screw provides quick, easy change of pressure setting.
4. Can be supplied with test lever.
5. Available with hold open device.
6. Available in semi-steel or steel with bronze or stainless steel trim.
7. Size range 4" to 30".

DAVIS REGULATOR COMPANY
2508 S. WASHTENAW AVE. CHICAGO, ILLINOIS

DAVIS VALVES
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REGULATOR CO.

POWER PLANT *Construction News*

Calif., Long Beach—Water Department is having plans completed for new water-treatment plant in vicinity of Spring St. and Newport Ave., consisting of several structures, equipped for capacity of 25,000,000 gal per day. Cost estimated about $720,000. Proposed to ask bids in July for equipment, including pumping machinery and accessories, motors and controls, mixers, feeders and other apparatus. Taylor & Taylor, 725 South Spring St., Calif., and James M. Montgomery, 306 West Third St., Los Angeles, are associated engineers.

Ill., Chicago—Rheem Mfg. Co., 7600 South Kedzie Ave., steel barrels, drums, etc., plans one-story addition, about 150 x 300 ft. Electric power equipment will be installed. Cost reported close to $200,000, with machinery. Main offices are at 570 Lexington Ave., New York, N. Y. Brown & Matthews, Inc., 122 East 42nd. St., New York, is engineer.

Ind., Rockville—Electric Light Department has plans in progress for extensions and improvements in municipal steam-electric generating station, with installation of new 750-kw generator and accessories, condenser, cooling tower, stokers for present boilers and miscellaneous equipment. Also switchboard and other electrical apparatus. Cost about $140,000. Financing in part has been arranged through Federal aid. J. M. Rotz Engineering Co., Merchants' Bank Bldg., Indianapolis, Ind., is consulting engineer.

Iowa, Waverly—Light and Power Department has plans in progress for extensions and improvements in municipal steam-electric power plant, with equipment installation for increased capacity. Surveys and estimates of cost are being made. Stanley Engineering Co., Hershey Bldg., Muscatine, Iowa, is consulting engineer.

Kan., Emporia—Department of Utilities, E. W. Daniels, commissioner, plans installation of new pumping station, with motor-driven pumping machinery and accessories, in connection with extensions and improvements in municipal waterworks. Also will make extensions and improvements in filtration plant. Estimates of cost are being made. Black & Veatch, 4705 Broadway, Kansas City, Mo., are consulting engineers.

Md., Baltimore—Consolidated Gas, Electric Light & Power Co., Lexington Bldg., Baltimore, is reported planning expansion in Riverside steam-electric generating station, with installation of turbine-generator, high pressure boilers, and auxiliary equipment; enlargement of switchyard and extension in transmission lines. Entire program will cost in excess of $6,000,000.

Mass., Fitchburg—Directors, Y. M. C. A., William S. Brown, 42 Dudley St., in charge, plans installation of boiler plant for central heating service in new Y. M. C. A. building; also will install swimming pool and other facilities. It will be of multi-story type, estimated to cost approximately $500,000. Tessier & Maloney, 220 Dwight St., Springfield, Mass., are architects.

Mass., Newton Upper Falls—United Equipment Co., machinery and parts, plans installation of electric power equipment in new one-story plant unit, reported to cost approximately $100,000. Project has been approved by CPA, Federal agency, and work is scheduled to begin soon.

Mich., Ypsilanti—State Department of Institutions, Lansing, Mich., has had plans prepared for expansion and improvements in power plant at State Hospital, Ypsilanti, with installation of equipment for increased capacity. Proposed to carry out work soon. Ayres, Lewis, Norris & May, Wolverine Bldg., Ann Arbor, Mich., are consulting engineers.

Minn., St. Paul—Waldorf Paper Products Co., 2236 Myrtle Ave., corrugated paper boxes and containers, plans installation of electric power equipment in new one-story addition for increased production. Cost reported close to $85,000, with machinery. Work on superstructure will begin soon. Alan C. Fleischbein is company architect.

Mo., Independence—Municipal Light Department has plans for expansion and improvements in municipal steam-

FUEL FLEXIBILITY—DOLLAR EFFICIENCY

featuring WATER COOLED STOKERS

WATER COOLED STOKERS
PROVIDE *Important Advantages*

- . . . Maximum Fuel Flexibility.
- . . . Increased Reliability.
- . . . High Operating Efficiency.
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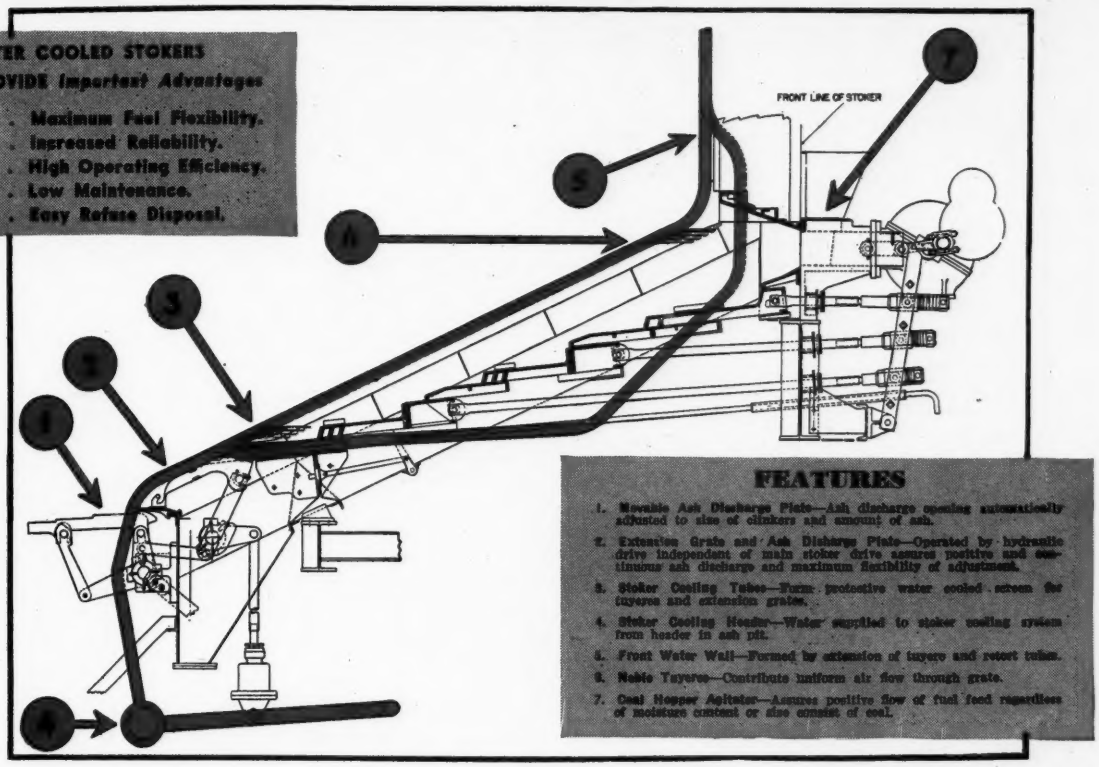
- . . . Easy Refuse Disposal.



FEATURES

1. Movable Ash Discharge Plate—Ash discharge opening automatically adjusted to size of clinkers and amount of ash.
2. Extension Grate and Ash Discharge Plate—Operated by hydraulic drive independent of main stoker drive assures positive and continuous ash discharge and maximum flexibility of adjustment.
3. Stoker Cooling Tubes—Form protective water cooled screen for tuyeres and extension grate.
4. Stoker Cooling Header—Water supplied to stoker cooling system from header in ash pit.
5. Front Water Wall—Formed by extension of tuyere and retort tubes.
6. Noble Tuyeres—Contribute uniform air flow through grate.
7. Coal Hopper Agitator—Assures positive flow of fuel feed regardless of moisture content or size consist of coal.

NEW CONCEPT OF COMBUSTION EQUIPMENT DESIGN

Modern design practice, accepted by equipment manufacturers, consulting engineers and consumers, requires that new combustion equipment provide utilization flexibility that will permit the efficient use of the range of coals which are economically available in each market.

FUEL FLEXIBILITY—DOLLAR EFFICIENCY

The fuel specification for design purposes should include the critical characteristics of the range of coals which sound fuel planning forecasts as competitively available. The ability to select the best fuel value available at any time to obtain the lowest overall steam cost gives the highest dollar efficiency.

WATER COOLING PROVIDES FLEXIBILITY

The illustration shows how one manufacturer of underfeed stokers has provided water cooling for the tuyere rows and furnace to obtain independence from variations in the ash softening temperature, volatile content and size consist of the coals which can be satisfactorily used.

FAIRMONT COAL

The Fuel Investigation reveals that in most markets Fairmont Coal will continue to be an excellent value in the foreseeable future. Many Utilities and Industrials are using the characteristics of Fairmont Coal in their Fuel Design Specifications in order to insure proper Fuel Flexibility and low-cost steam for their new plants.

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Write for Reference Bulletin No. 5 for the details on investment required for flexibility in plants requiring 400,000#, 200,000#, or 60,000# of steam per hour. Your request will automatically put your name on our mailing list. P546

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ADSCO

EXPANSION JOINTS

Engineered for RELIABLE PERFORMANCE

● Every man responsible for the installation, performance and maintenance of steam, hot water, oil and gas lines should have complete data on ADSCO Expansion Joints. Available in single and double joints for high pressure and high temperatures,—flanged and bevelled ends.

The ADSCO Piston-Ring Expansion Joint illustrated above makes it possible to add packing without shutting down the system. It is another outstanding example of ADSCO advanced engineering.

Write for Catalog No. 35-E

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.
MAKERS OF UP-TO DATE STEAM LINE EQUIPMENT FOR OVER 65 YEARS

electric power plant for increased capacity, installation to include new turbine-generator unit, condenser, boiler and accessory equipment. No official estimate of cost announced. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Neb., Ord—Electric and Water Department has plans under way for expansion and improvements in municipal power station, with installation of additional equipment for increased capacity. It is understood that a new Diesel engine-generator will be installed. Cost about $125,000. CPA, Federal agency, has approved project. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

N. H., Berlin—Brown Co., kraft and other papers, plans installation of electric power equipment in connection with expansion in mill, including new sulphate pulp mill, dryer building and other structures. Entire program will cost close to $1,000,000. Power supply facilities at mill will be increased. Work is scheduled to begin soon. Rust Engineering Co., Clark Bldg., Pittsburgh, Pa., is engineer and will supervise construction.

Ohio, Miamisburg—Miamisburg Paper Co., Division of American Envelope Co., writing papers, plans installation of electric power equipment in new one-story and basement mill addition, about 300 x 500 ft. Cost reported over $450,000, with machinery. An air-conditioning system will be installed. Proposed to begin work soon. W. Ray Yount, Third National Bank Bldg., Dayton, Ohio, is architect.

Ohio, McArthur—Village Council, McArthur (Vinton County), is considering installation of a municipal power plant. Proposed to use Diesel engine-generator unit and accessories. An engineer will be selected soon to make surveys and estimates of cost.

Ohio, West Jefferson—Village Council has authorized surveys and estimates of cost for a new municipal power station, using Diesel engine-generating unit and auxiliary equipment. Proposed to engage an engineer soon.

Ore., Weston—East Oregon Canning Co., Weston, plans installation of electric power equipment in new processing and canning plant on local site, consisting of several one-story buildings, to be equipped for large output. A boiler house is planned. Entire project estimated to cost close to $200,000. Proposed to begin work during summer.

S. C., Greenwood—Greenwood County Electric Power Commission, Greenwood, has authorized plans for new steam-electric generating station, to be equipped for capacity of about 10,000-kw, with turbine-generator, boiler and auxiliary equipment. It will be operated in conjunction with present hydro-electric generating station at Buzzard Roost, and is reported to cost approximately $1,000,000. George Hill, Wellford, S. C., is consulting engineer.

S. D., Mitchell—Northwest Public Service Co., Huron, S. D., plans expansion in steam-electric generating plant at Mitchell, with installation of additional equipment for increased capacity. Proposed to begin work in fall. Cost reported about $1,000,000. Company also plans new transmission line from Mitchell to Aberdeen, S. D., and will carry out construction early in 1947.

Texas, Austin—Water, Light and Power Department, Municipal Bldg., plans extensions and improvements in municipal steam-electric power plant, including installation of additional equipment for considerable increased output. Cost estimated about $770,000. Proposed to arrange bond issue in that amount.

Texas—Corpus Christi—Corpus Christi Cold Storage Locker Co., 616 South Staples St., has plans for new one-story food processing and cold storage plant for locker service. Cost reported about $140,000, with equipment. Proposed to begin work soon.

Utah, Salt Lake City—Fisher Brewing Co., 160 South 10th. West St., has plans for new one-story addition, about 55 x 200 ft, for expansion in bottling and other departments. Electric power equipment will be installed. Entire project is reported to cost close to $100,000. Caldwell & Richards, Templeton Bldg., Salt Lake City, are architects.

Wash., Spokane—Ainslie Co., 304 East Second Ave., paper boxes and containers, has plans for new two-story addition, about 100 x 140 ft, on adjoining site, for considerable increased capacity. Electric power equipment will be installed. Cost reported over $100,000, with machinery. Proposed to begin erection soon. Ralph J. Bishop, Northwest Lift Bldg., Spokane, is architect.

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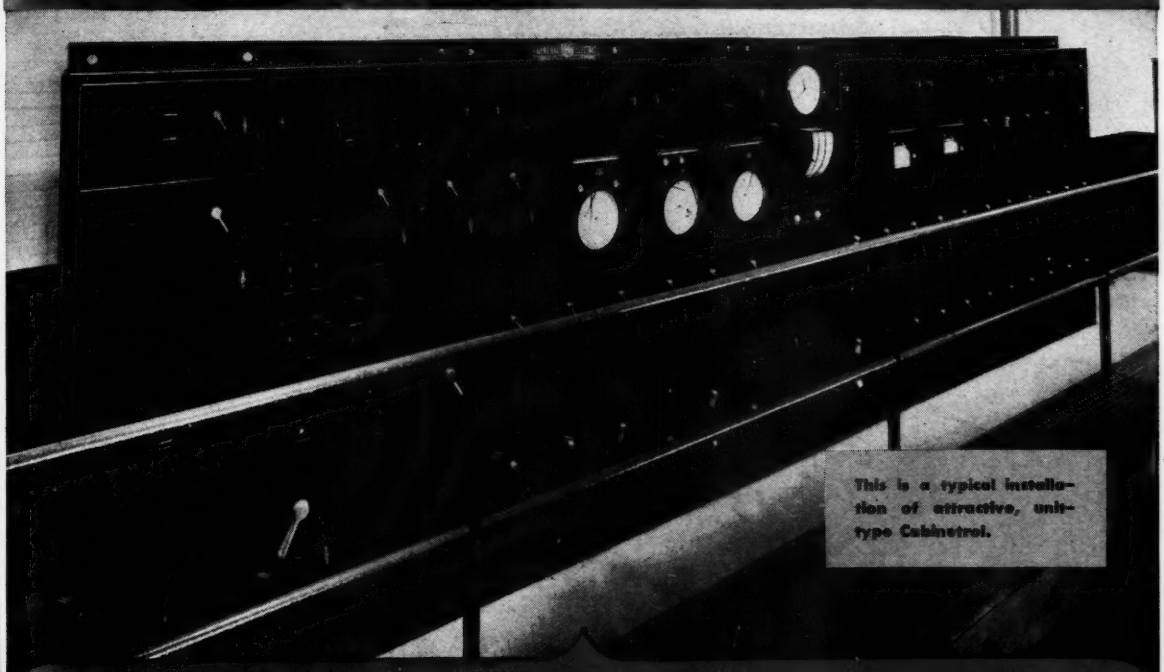

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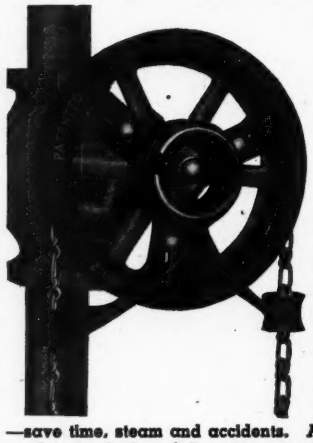

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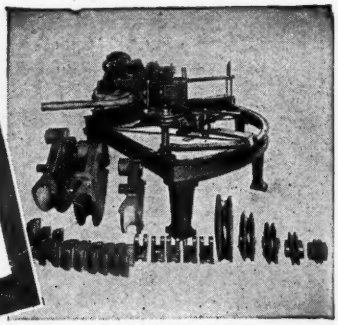

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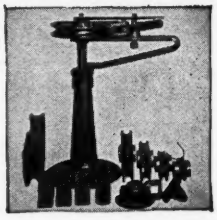

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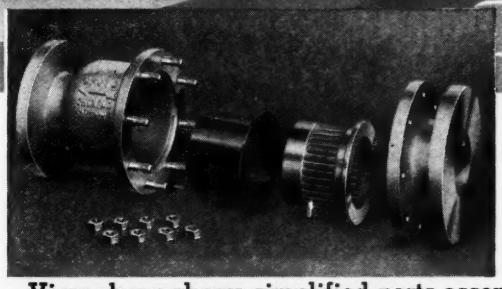

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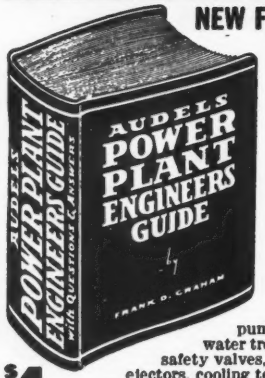

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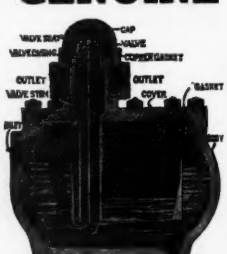

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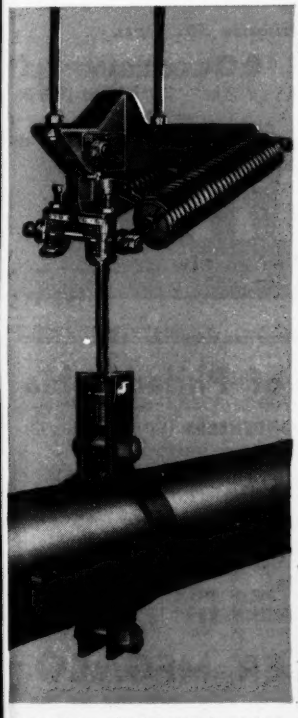

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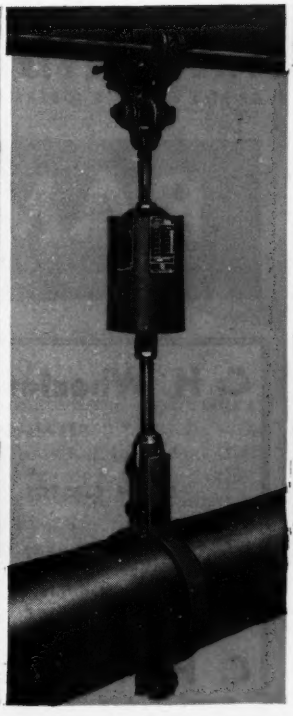

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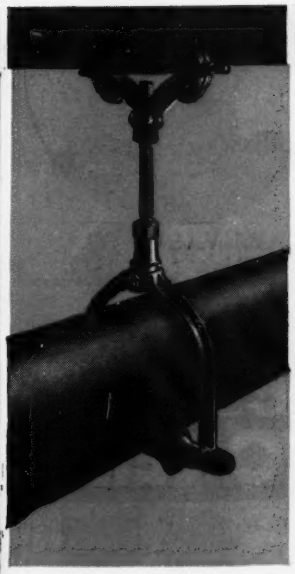

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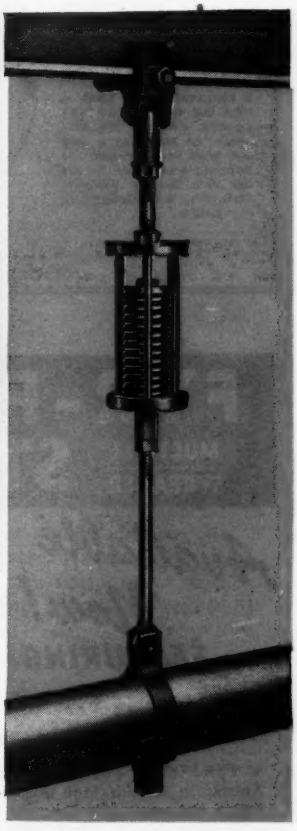

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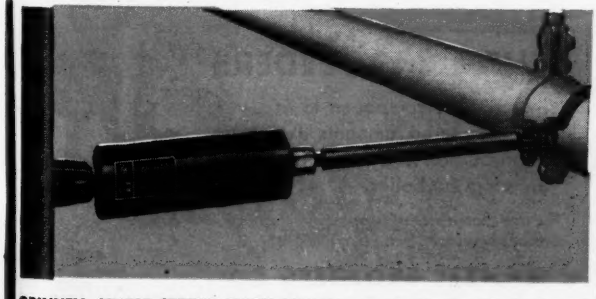

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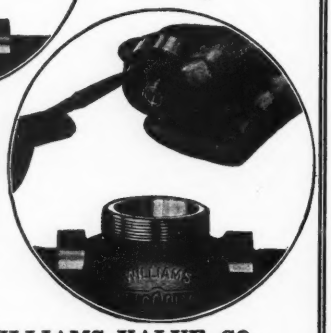

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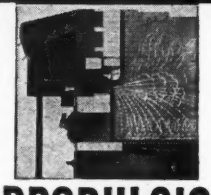

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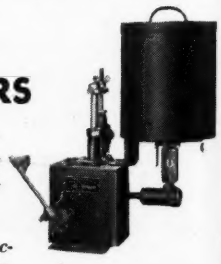

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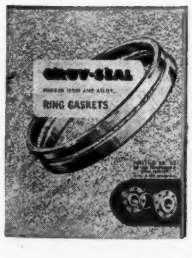

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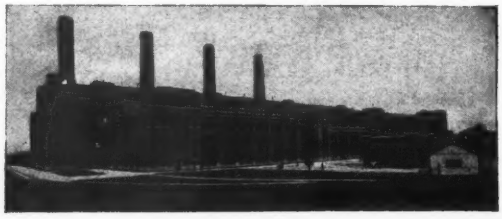

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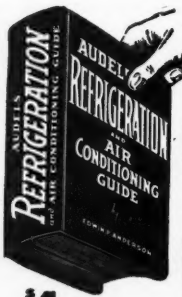

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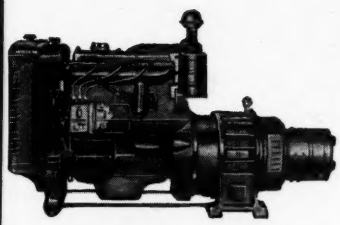

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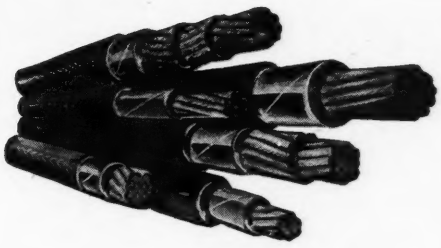

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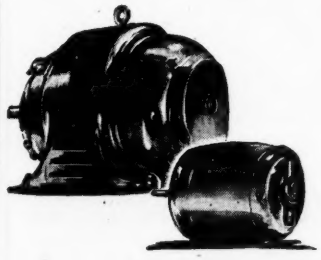

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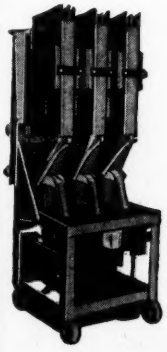

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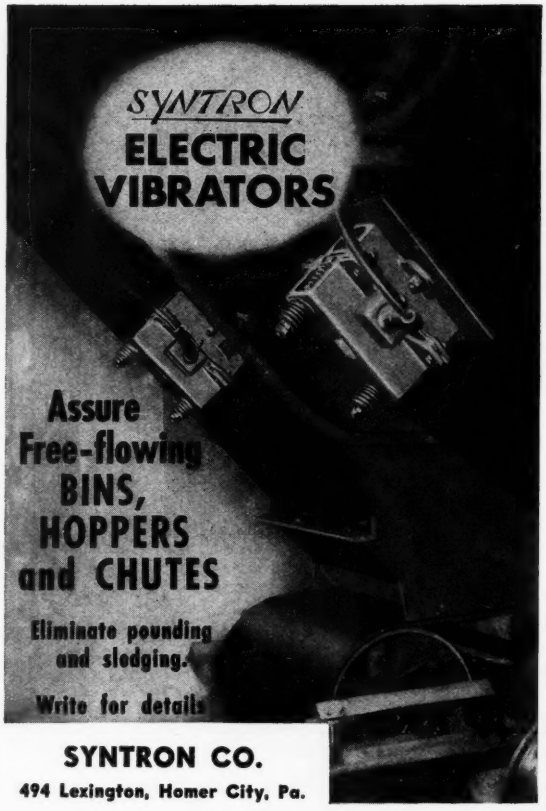

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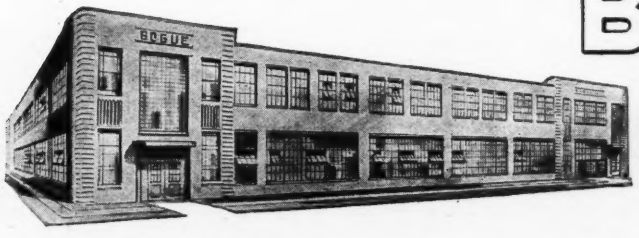

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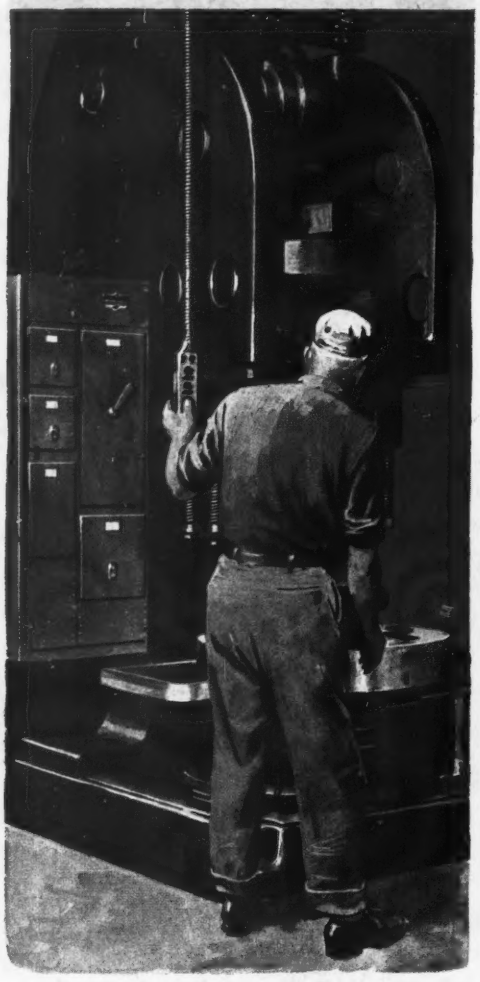

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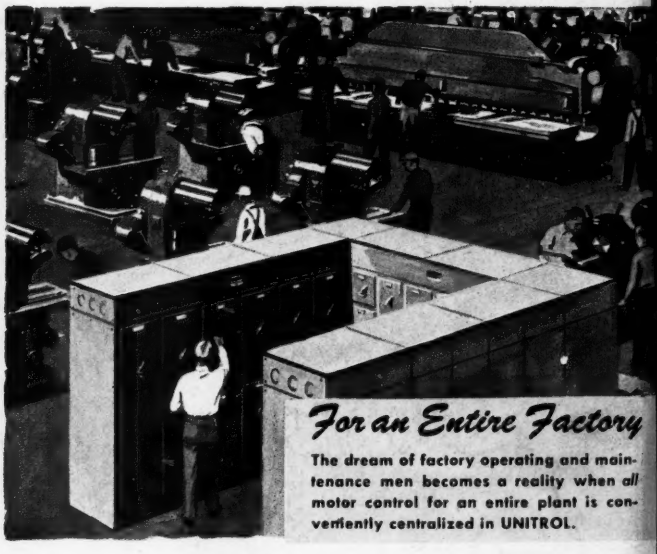

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